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THE KOREA'S WARDROOM MESS.

A TRUE STORY.

Repeated With Comments By REAR-ADMIRAL CASPAR F. GOODRICH, U. S. N.

A famous French writer on gastronomy is responsible for the aphorism:—"dis-moi ce que tu manges, et je te dirai ce que tu es." There is much wisdom in this epigram yet I believe that it contains only a moiety of the truth. The other half I should phrase thus:—"dis-moi *comment* tu manges, et je te dirai ce que tu es." Taking together "what one eats" and "how one eats it" we obtain an accurate index of one's social development. In this instance it is not alone the manner which makes the man; no less important a share in the making is lodged in the matter; it can hardly be denied that this nice adjustment was in the poet's mind when he wrote,

"But civilized man cannot live without dining."

It is impossible to exaggerate the influence upon our well-being, both physical and mental, of a daintily set table, at which good, well-cooked food is served by neatly attired, quiet, orderly and skilful servants, in an apartment so furnished as to soothe the senses and lull the willing guest into that holy calm which is the

concomitant of healthy receptivity. In our ordinary existence, nature or custom, as you will, imposes on us the obligation of three meals a day. Surely it is fitting and proper to aid the discharge of this obligation in all reasonable ways. While it is entirely correct to hold that a pleasant repast presupposes the presence around the board of congenial spirits, of a conversation touching upon subjects of interest just enough stimulating in their character to maintain an easy flow of talk, but skilfully piloted to avoid those topics which arouse antagonisms or heated discussion, we cannot ignore the part in this happy result played by the caterer, the steward, the waiters and last, but not least, the cook, who together lay the foundation upon which is erected that superstructure of wit, jest, badinage, anecdote and episode, the very demonstration and crown of an agreeable repast. It is possible to arise from a picnic of cold sardines and biscuit, washed down by spring water and feel that in the company with which we are honored ample atonement is found for any deficiency in the bill of fare. Such experiences must, however, be the exception and not the rule. Life is not a continual picnic and proper respect for the demands of our appetite, not only as to "what" but as to "how" compels us to pay some attention to the details of the day's triple ceremonial which, if not carried too far, will amply reward us in a genial satisfaction with our surroundings, a larger sympathy with our neighbors and a toleration or even rosy view of these sublunary affairs in general.

There is a reverse side to this medal, reflecting the result of wilful or careless indifference to the art of the late lamented Brillat Savarin, which concerns us only in so far as it affects that chief aim of all naval officers—the good of the service. Unless gastronomy and the efficiency of the ship can be linked together as interdependent the former has no place in our technical discussions and its consideration in the pages of these grave and valuable proceedings is as out of place as a clown in a ball room. Let us see, therefore, whether or no good messing and a healthy tone in the man-of-war's atmosphere may not go hand in hand.

It has, I fear, been the lot of other officers in the navy besides myself, on occasion, to serve on board of a ship where harmony was distinctly absent. The reason of this regrettable state of affairs differs of course with the individual case. Sometimes it may be found in the physical discomforts of the ship's design; or the futile arduousness of the duty assigned her; or persistently

boisterous and inclement weather; or an over-tropical or over-boreal climate, too long extended; or continued remoteness from civilization; or needless deprivation of communication with those at home; or the uneven administration of affairs on board; or a captain who seems animated by the fiend's desire to render all work difficult and distasteful; or an executive officer who fails to command the professional respect and personal esteem of his messmates; in short, a host of reasons into whose enumeration it is not worth while to enter. I think, however, no one will deny that, in every instance coming within his knowledge, one condition invariably obtained; *his mess was unsatisfactory*, his bodily nutrition not a pleasure but an obligation imposed upon him by the necessity of supplying his physical wants. I am almost tempted to go so far as to assert that, on board of *all* unhappy ships, the mess, and by that I mean particularly the "wardroom mess," falls conspicuously short of what it might be and what it should be; while on the other hand, no matter how unsympathetic or harsh the exercise of command on ship, that no ship is really unhappy wherein the "wardroom mess" is properly conducted. While this may not be the unbroken rule, I am sure it has been my unvarying experience.

I believe that too little attention is paid to this point by officers afloat; that they accept poor and badly cooked food, a slovenly table and slip-shod service as a matter of course, an unavoidable incident of the profession, a hardship to be endured patiently as one of the customary conditions of sea life. The incomprehensible part of this fatalistic attitude is that it is assumed with a resignation worthy of the cloistered nun by men who would not in their own homes tolerate for a moment the least departure from the daintiest standard. They receive uncomplainingly, at the hands of an Asiatic or African steward, what would produce a domestic quarrel only to be settled by the husband or wife taking a trip to North Dakota and its accommodating divorce court. In my judgment, their view is hideously incorrect. Our ships nowadays are generously supplied with everything essential, both in material and personnel, to a well ordered table and an excellent bill of fare. It is only the apathy of the officers themselves that is responsible for their not having everything about them of the nicest. That this opinion is not held as a theory but is based upon facts, I propose to show by repeating the story of what happened once upon a time in the Korea as related

to me by an officer whom I shall term "X," in deference to his desire for anonymity. I hope he will forgive me for this *quasi* betrayal of his confidence.

"X" always maintained that the chief cause of indifferent food, wretched cooking, miserable servants and an unattractive table lay in the dependence implicitly placed by the average naval officer upon the steward; that the steward's place is and should be subordinate; that he should only execute the orders received from the caterer; and that the caterer must do something more than to act merely as the mess treasurer. For the benefit of his colleagues I am led to present the picture of "X's" active management in one case which he has been induced to quote at length, leaving it to them to decide whether or not he was justified by his practice in cherishing and expounding so radical a doctrine. He began at the beginning and spun his yarn much as I am giving it.

Some years ago he was assigned to duty as executive officer of a vessel about to be placed in commission. This was, by the way, before the present liberal régime of the Navy Department was instituted by which officers' messes are furnished with china, silver, glass, table linen, etc., and when no small number of dollars was exacted of each member of the mess in order to secure a "mess outfit." Practically nothing was provided by the government except a few (a very few) cooking utensils; everything else had to be purchased by the officers themselves. It happened that "X" preceded his messmates by a few weeks, having been ordered to duty in connection with preparing the Korea for commissioning. As soon as the list of his messmates was completed and made known, he addressed to each one a communication requesting authority to make temporary arrangements for messing prior to their arrival. To these letters he received in all cases affirmative replies. Acting upon this authority, "X" shipped an excellent steward, an approved cook and a few mess attendants, just enough to start with. From a restaurant on shore he rented, temporarily, some china, glass, linen, plated ware, etc. He then wrote that, instead of going to a hotel, the officers might repair directly on board the ship where they would find their rooms in readiness. As a fact they did so come and shifted into the prescribed uniform for reporting to the commandant of the navy yard. From the office of the latter officer they returned to the ship and reported to the commanding officer for duty, the

pennant having been hoisted. Immediately afterwards, the wardroom mess sat down to a decently spread table and partook of a good luncheon. An organization was effected, a caterer elected and empowered to buy the "outfit." It would seem as if a mess beginning existence under such auspices could not fail of success. Unfortunately it belied its augury, and started down hill at once, surely and steadily. There were a few spasmodic bursts towards better things but the general decline was not interrupted although each month the members felt that it was impossible for things to be worse and that the change of catererships which occurred with every new moon must result in a marked improvement. In practically every case these fond anticipations yielded to keen disappointment.

For nearly two years this deterioration continued. The mess bill was always high, the food was always poor, the servants always inefficient. Poor creatures! it was inevitably upon their guiltless heads that the universal dissatisfaction was vented. When not cowed by incessant rebuke they were indolent and careless. How, indeed, could they be expected to take more interest in their duties than did their masters?

One day the caterer, whose traditional term of office had not expired, rose from his seat at the table, threw down the account book and with it tendered his resignation in forcible terms; he stated, what was known to all, that most of the china and glass was broken and the table linen worn out; he added that the mess was heavily in debt, owing several hundreds of dollars; he mildly advanced as a saving clause that the storeroom was well filled with provisions; and he concluded that he would have no more to do with the caterership. This officer had about completed the full tally of the occupants of the wardroom, each of whom had had his trick at the wheel and had resigned more disgusted than his predecessor with the annoyance of a thankless office. When a resignation is tendered in such a spirit there are two courses open; one, to accept it as quickly as possible; the other, to compel the recalcitrant gentleman to take an extra tour. As the latter method involves the certain punishment of the entire mess it is not to be highly recommended. In this case, the caterer's resignation was accepted and a solemn stillness fell upon all. What was to be done? At this juncture "X" arose and nominated himself for the vacant office. His readiness to assume so undesirable a task was greeted with a rapture which may be well

imagined. But "X" qualified his candidature by laying down certain conditions to be observed by the mess if it desired his services. In the first place, he stipulated that there should be no discussion of mess matters in public; no criticisms of the food; no reference to the cook or his cooking; to the steward or his delinquencies; above all, no chiding of the mess boys; that any complaints touching mess affairs should be made in private to *him*, promising that he would endeavor to remedy any defect if his attention were called to it in this manner, but firmly refusing to pay the least attention to a public complaint except to request that the mess discipline the officer guilty of so gross an infraction of its own rules; that he should not pose as a caterer in the readily accepted term; that things had reached such a pass that what the mess wanted was not a caterer but a dictator, a tyrant with complete powers; that the mess bill would be fixed at thirty dollars per month; that no additional assessment would be levied at any time for any purpose whatsoever; that he should endeavor to pay off the indebtedness by careful regard to economy; that, if elected, he would accept the office for no definite period of time; that what he desired in common with the rest was to see the mess running in a satisfactory manner; that as he could only please one person, to wit, himself, he would not undertake to satisfy some eighteen or twenty others; that until the mess had arrived at such a condition, of which he alone should be the judge, there would be no election of a caterer; that a vote of want of confidence on the part of the mess would naturally end his tenure at any moment; that when the mess attained the degree of development at which he aimed he would then resign the caterership; that he proposed to spend some of the mess money in unaccustomed ways, in order to secure the comfort of its members; that he would not, unless so desired, explain the nature of these outlays hoping that the officers would have sufficient confidence in his judgment and integrity to believe, without proof, that this money would be wisely laid out; that every member must, so far as mess matters were concerned, yield cheerful and unquestioning obedience to any of the directions which the caterer might formulate; lastly he desired a unanimous election. With the exception of one foolish member who voted in the negative, as he explained to "X" more in a spirit of jest than otherwise, all of these conditions were accepted not only without reluctance, but with eagerness, and "X" took charge.

"X" held to be true the very converse of service public opinion, which exempts the executive officer from acting as caterer, believing that (if he only will) this individual is peculiarly fitted by the power lodged in his hands to establish and maintain the military virtues of an inflexible mess routine and of a high standard of drill and efficiency on the part of the servants.

At this time the wardroom of the Korea left much to be desired on the score of neatness while the personal wants of the officers were attended to by the mess attendants in a slip-shod and perfunctory manner. "X's" first care, therefore, was to thoroughly clean the wardroom in every nook and cranny; to break out, scrub, and renovate the pantry which, by the way, was in close proximity to the officer's sleeping apartments; to make out stations for the boys so that each square foot of paint work, along the sides and bulkheads and over head, and each square foot of deck was the task of some particular boy and to define in writing the scope of each one's duty whether daily or periodical. As executive officer, "X" possessed, as he admitted, certain great powers which had been wanting in his predecessors. He applied these powers by sending for the master-at-arms' assistant (ship's corporal was the rating in those days) and giving him charge of the wardroom and of the wardroom boys during the morning watch. This was the programme. When all hands were called he was to muster the boys at once, take them into the wardroom and see that each performed his allotted share of the general cleaning, the washing of the paint work and of the oilcloth on the floor, the polishing of the brass sills at the doors, and of the other bright work, etc. This done, each boy took the clothes and boots of the officers upon whom he waited outside of the wardroom, brushed and folded the former, polished the latter, and returned all to the rooms ready for use when the owner awakened. Each officer's bath was then prepared. The boys now were taken out on the berth deck and made to scrub themselves from top to toe; and, frequently, to change into clean clothes throughout. After this the officers were called and their breakfasts ordered. The master-at-arms' assistant was warned that this duty must be executed on the part of the boys with promptness, thoroughness and, above all, with silence; that for the satisfactory performance of this duty he would be allowed $10 a month from the wardroom mess funds conditional upon there being no discontent in this particular. Should complaint arise as to careless work on the

part of the boys or disturbing noises made by them during the morning watch, he would lose this *honorarium* but would still be compelled to perform the duty. The change in the appearance of the wardroom and in the comfort of the officers was immediate. As closing this part of the episode it may be said that no complaints were ever made, so that the ship's corporal enjoyed his monthly stipend of $10 to the end, while the officers entered upon a new phase of existence. Until after breakfast, at least, everything was as smooth and delightful as possible.

The catering in the strict sense of the word, that is to say the making out of the bills of fare had up to this time been left, as is still the unfortunate custom, in the hands of the wardroom steward. As a result it was practically impossible to distinguish one dinner from another. Day after day the wardroom mess had practically the same *menu*. In order to introduce a new and unwonted variety, "X" sat down at his desk the first evening of his encumbency and made out a general type of bill of fare for each of the three meals of the day. The breakfast was informal and consisted mostly of coffee, rolls and eggs, the latter in any shape the individual desired. Breakfast proper or lunch was at 11 o'clock. It was rather a French "déjeuner à la fourchette." For this, "X" decided that two hot dishes, a salad, fruit and black coffee would suffice; while dinner meant a soup, a fish, a roast, salad, dessert and fruit followed by black coffee. The question was how to arrange a series of bills of fare and avoid too frequent repetition. So he took another sheet of paper and, beginning with dinner, wrote down in a column all the kinds of soup he could think of and which inquiry proved to be among the accomplishments of the cook. Another column was then made following down every available kind of fish and way of cooking. The third column included the various kinds of meat such as beef, veal, mutton, turkey, fowls, etc., cooked in a number of different modes. The fourth and fifth columns gave a large variety of salads; and sweets. "X" now had the necessary elements for his table. To his surprise he found that he could easily make twenty odd dinner *menus* absolutely unlike each other before having to repeat. These he arranged systematically so as to secure a pleasing variety; then into two books he wrote these bills of fare, giving each its appropriate number. One of these books he retained, the other he placed in the hands of the steward. A similar procedure yielded an equal number of menus

for lunch, or breakfast as "X" preferred to call it; these again were entered into the record books mentioned. In the case of lunch, certain dishes were improvised of what was left over unconsumed of the preceding dinner, thus saving much which would otherwise have been wasted. This whole planning occupied not more than a couple of evenings of "X's" time and it answered at one blow the vexed question of "what shall we have for dinner tomorrow?" Every night the steward would come to the caterer, settle up his daily account of mess money received and expended and obtain his orders for the following day which usually took the form of "Well, steward, we had No. 17 today, we will have No. 18 tomorrow." Only by one who has sat down to the never-ending recurrence of the same dishes can the great relief in this change of living be appreciated. Instantly the whole tone of the mess altered while the actual work thrown on the caterer was practically nothing.

"X" perceived that *no matter how many officers were likely to be present at the table the same amount of mess money had always been expended each day* and he knew, moreover, that the full tally of covers at the table had always been spread. The frequent result of the latter circumstance was a broad and desert waste of linen, when in port, unoccupied save that here and there a member sat without a neighbor, for oftentimes a bare half dozen of the entire mess would be present. Every day "X," therefore, speculated upon the probable number of those who would be on hand the following day. Knowing, as he well did, the habits of the mess, he could estimate very closely the number of places to set and the amount of food to be provided; therefore, each evening he would tell the steward how many were expected at the mess the next day and would give him carefully considered directions as to the amount of food to be bought, placing in his hands barely sufficient money to cover this outlay. It was only at sea, as a rule, that all of the chairs were claimed by the officers; so, the wardroom table being in two parts, it was possible for "X" to have one table fairly well filled, daintily set and decorated. Starting off with a heavy initial indebtedness, "X" was enabled to save enough money out of the mess bills to pay off the outstanding obligations with great promptness.

Another feature of the new mess life was the cultivation of the aesthetic side of dining. "X" bought handsome rugs and carpets for the mess room floor; he hung in the skylights baskets of

vines and flowers; he bought pretty jardinieres for the table, and kept them filled with plants; he replenished the mess outfit of white china, for ordinary and for sea use; he bought a handsome set of decorated china for mess entertainments; he renewed the glass and linen and bought additional silver meat platters and dishes so that the service of the table might proceed on both sides at once. After struggling for a while with the wardroom steward, he changed him for a more competent man. Finally after four months or so of this new régime, wherein not a word of dissatisfaction ever reached his ears, he addressed to his messmates a speech which ran somewhat as follows:—"Gentlemen, when I assumed the position of caterer I made, as you remember, a statement that I would retain it until the mess should be running in a way satisfactory to myself. That end has now been reached; I am fully satisfied with the mess, with the food, with the cooking, with the table appointments and with the service. I may even go further and defy any one of you to say that he has ever before, afloat or ashore, lived as well as he is now living on board this ship."

To this challenge there was no answer.

"When I took charge the mess was deeply in debt, its outfit had literally disappeared. I have renewed the latter and discharged its debts. Your wardroom is clean and it possesses many handsome decorations which make it a beautiful and attractive home. Your immediate wants are well provided for and the mess attendants are cheerful, respectful, and well trained. The wardroom mess of this ship owes not a single penny and I hold in my hand a bag containing $25 in gold for each member. Under these circumstances I am justified in tendering my resignation and in begging that you accept it and choose my successor."

The answer came in a chorus of appeals to the effect "Don't leave us now. You have brought us out of the wilderness. We are happy and more than contented and we implore you to retain the caterership. It does not take half an hour of your time a day." "X" could not remain insensible to this urgent demand, neither could he deny the allegation that the whole business of running the mess consumed only a few minutes daily. So complete was the organization that things ran as smoothly as clock work. He remained attached to that vessel a few months longer and only gave up the caterership when he received his orders home. In the meantime, he paid out of the funds, for a hand-

some gift voted by the mess to the wife of a retiring and much-beloved captain; defrayed, without extra assessment, the whole share of the wardroom officers in a series of entertainments in a very hospitable port among a critical and refined community; nevertheless he had increased the amount of gold in hand by another $10 and was contemplating a large reduction in the monthly mess bill.

The typical and practical working of the schedule of bills of fare was shown in a sea passage of about ten days. At the bottom of the mess refrigerator was placed a heavy layer of ice; upon this were spread out the materials say for No. 10; then a layer of ice, then No. 9; another thin layer of ice, then No. 8; and so on. The result was that on the day of the ship's arrival in port the wardroom mess dined sumptuously and wound up with ice cream, a luxury unprecedentedly rare in those days. All this was prior to the introduction on board our ships of cold storage rooms and ice machines. "X's" story is corroborated by his messmates, who recall with pleasure the change from the poor messing, squalid table, and the absence of things pleasing to the eye in the mess room itself to the excellent fare and its aesthetic accompaniments, the outcome of a very small application on the part of the caterer of the care and forethought which every officer must exercise in carrying out his daily tasks on board ship. If these things were more costly than the usual mess service I should only say that "X's" methods were for those who can afford them, but this he distinctly assured me was not the case. They are productive not only of that harmony of spirit which renders the wardroom independent of irascible skippers and disagreeable duty, but also of a distinct economy in expenditure. There is really no excuse for a mess table whose only decorations are a bottle of unspeakable catsup, a cloth stained with the souvenirs of previous meals and a row of napkins each in its own ring proclaiming too unmistakably a second, or third, or sixteenth appearance. Officers owe it to themselves and to the good name of their ship to have everything as fresh and dainty as if they always expected ladies as their guests.

Moreover, the same dignity and formality of service should be insisted upon at every meal without exception; otherwise the waiters grow slack and careless so that the presence of a stranger or two throws them into "conniption fits" in which they stumble over each other and possibly spill the soup on some costly gown.

"X" mentioned quite incidentally a rule adopted by the wardroom mess of the Korea at the beginning of the cruise, which he asserted had been of great value in banishing unfortunate topics of conversation. Either explicitly or implicitly, it may be found in the navy regulations, still he thought the mess wise in giving expression to the unequivocal sentiment of its members. By this rule it was forbidden so much as to refer to the President of the United States, the Secretary of the Navy, the Commander-in-Chief, or the Captain of the ship. Whether for praise or blame their names were *taboo*. Moreover, nothing was permitted to be said to which a lady might not listen with "ears unvexed."

Surely a few little silver bonbonnières, even if not filled with Huyler's best, a few similar dishes with olives and salted nuts, a handful of flowers in small cut glass bowls or silver vases, some sprigs of green about the center, a darkened room, the only light thrown by shaded candles on the table itself, spotless linen, not more than one or two vacant seats, all these cost next to nothing and they make dining a real pleasure, drawing messmates together in the bonds of a good comradeship which will inevitably manifest itself in a smart ship with an enviable record for general efficiency and a high standing in the target score.

The individual napkin, mostly soiled, should be banished, "X" averred, with the equally nauseous individual salt-cellar. Nice little breakfast napkins neatly hemstitched cost less than $1.50 a dozen. To keep them fresh, should be a regular duty of the mess attendants. Water and soap are not unprocurable on board ship, while an electric flat iron, at say $10 or $12, would make the pressing of two or three dozen daily, the work of a few minutes at most.

Upon interrogation, I elicited from "X" a few hints drawn from his experiences which I take pleasure in repeating. He thought it most unwise to lock up mess money in stores unless absolutely required for an extended cruise at sea. Theoretically, he said, it is economical to buy in large quantities, practically it is better to live almost from day to day. A well-filled storeroom tempts to extravagance, sometimes to pilfering, on the part of the cook and steward. For example, the former's failures go overboard and fresh supplies for a second trial come from the storeroom while no one is the wiser. Be liberal, he said, in supplying the cook with special utensils and forms which encourage and facilitate loftier flights in his art. Few cooks, he found, can

be trusted with pepper. Generally they use this condiment to conceal the defects in their work. The foundation of all his soups and sauces being a rich stock, do not begrudge him the necessary materials in the shape of shins and knuckles. They seem to cost a good deal but in reality they are money-savers. Borrow from the French their "pot au feu" and chuck into it the unused portions of joints and meat bones. It will yield an excellent "potage maigre."

"X" was further good enough to show me a few of his schedules. No. 10 ran thus:

Lunch.	*Dinner.*
Clam broth.	Soupe à la Reine.
Corned beef hash.*	Lobster farcie.
Lyonnaise potatoes.	Stuffed breast of veal.
Tomato salad.	Mashed potatoes.
Cream cheese.	Summer squash.
Fruit.	Asparagus salad.
Coffee or tea.	Floating Island.
	Fruit.
	Coffee.

No. 11 shows the lapping over from yesterday which makes for thrift:

Lunch.	*Dinner.*
Fried pan fish.	Vegetable soup.
Minced veal on toast.	Broiled fish.
Baked potatoes.	Boiled fowl.
Baked apples and cream.	White sauce.
Fruit.	Stewed potatoes.
Coffee or tea.	Stuffed peppers.
	Lettuce salad.
	Cheese.
	Farina with cream.
	Fruit.
	Coffee.

When I inquired how he was sure of the quantities needed for these bills of fare he replied that every housekeeper knows them, if not intuitively then, by experience. He gave me the quantities he thought Nos. 10 and 12 would require but I have not cared to turn this appeal for better living into a cookery book. The earnest seekers after truth may consult Mrs. Rohrer, Miss Marion Harland or other accepted authorities.

* From the dinner of the preceding day.

For each season, a new set of schedules would be demanded. Moreover, he had found it expedient to authorize the steward to substitute other dishes for those named in the schedule if the market did not offer what was called for in proper quality or if something particularly good was obtainable. For any departure from the written text, however, the steward had to make satisfactory explanation. The latter submitted his proposed list of purchases each evening to "X" who discussed and amended, when necessary, calculated the probable amount of the whole bill and gave the steward the money. The latter's "rake off," for which most wardroom messes appear to exist, must have been scanty at best, yet in the service today "X" believed it could be estimated by the hundreds of dollars every month. "X" thought that $30 a month might fairly be charged when a great deal of entertaining was done, the wine included: that on our own coast, where stays in port are long, leaves of absence frequent, and the markets cheap and plentiful, $20 a month ought to be ample. *A general level of habitual good living should be aimed at and banquets should be avoided at all hazards.* He also condemned the foolish weakness of allowing any servant his ration, whether it be cook, steward or mess attendant. Nothing is gained thereby and the mess bill is just that much higher.

I may be permitted to add a reflection of my own to the effect that the abolition of the evening dress coat and its replacing by a blue mess jacket similar to that which was in use when I entered the service would be a great blessing; it would by choice be habitually worn at dinner and would complete the picture of an attractive table surrounded by gentlemen in comfortable, easy, and befitting attire.

I hope I am not wrong in thinking that "X's" methods very properly merit the consideration of all who would wish to raise the standard of living and lower the mess bill, producing results most striking in their outward effect while adding materially to the comfort of the wardroom messes and incidentally to that contentment which is an indispensable condition for every zealous officer and every creditable ship.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A STUDY OF ATTACKS UPON FORTIFIED HARBORS.

By LIEUT.-COMDR. W. L. RODGERS, U. S. N.

(*Continued from No. III.*)

THE CAPTURE OF PORT ROYAL, S. C., IN 1861.

A PURELY NAVAL ATTACK, YET UTILIZABLE ONLY THROUGH THE PRESENCE OF A SUPPORTING ARMY.

The examination of the naval attack of harbors in our Civil War is particularly interesting, because with the navy, as with the army, the development of tactics during the war was very great, and starting with rather crude ideas in 1861, at the close of the war our practice was as far advanced as any nation has since gone.

During this war our navy was used almost entirely in maintaining a blockade of the coast, and in patrolling the great rivers to aid the armies in the field. It seems that if we stop a moment here to study the respective fields of work of armies and navies it may serve to clear our minds so as to judge wisely as to what operations of coast and harbor attack it is proper to undertake, and therefore what points are likely to be attacked in force. Both the army and navy, of course, are merely instruments of diplomacy and high politics; in a war the immediate object of any army or of any fleet under normal circumstances should be the destruction of the armed forces opposed to it, but when this has been done, the ultimate objectives of the two services are entirely different, that of the army being primary, and that of the navy being altogether auxiliary.

In short, it is the duty of a field army after it has subdued opposition, to occupy the country, to convert itself into a territorial garrison and control the inhabitants, their laws and their daily life, so that under this shield the profits of the industries and

commerce of the conquered country may be diverted to the treasury of the conqueror. As extreme examples of this ultimate use of an army we have in ancient times, the occupation of the Roman provinces by the imperial armies, in modern times the occupation of India by Great Britain. Each case covers a period of centuries in which after every advance the invading and conquering army settled down in garrison, and under the imperial peace a great stream of tribute, more or less concealed under commercial forms, flowed to Rome or London. In each case the monotonous patrol and sentry-go of the ex-patriated legions was, with reference to the home empire, productive labor, feeding and clothing millions of compatriots who never left their firesides.

To be sure, conquering nations do not always care to recoup and reward themselves for their losses and efforts by an annual payment collected through the presence of a permanent garrison. It is often thought better, as by Germany in 1871, to commute the annuity into capital by collecting a great war indemnity in two or three years, and then withdrawing the garrison whose occupation served as guarantee for payment; and there are other terms of settlement which may be agreed upon.

The navy has a minor rôle; it cannot occupy territory nor search out and control people and their business, therefore it can do nothing in peace to support the home country.

In war, after the navy has defeated the forces opposed to it, its duty is the auxiliary but very important one of maintaining the communications, both military and commercial, of its own country while breaking up in every way those of the enemy. A navy has no other legitimate object. If it is employed for other purposes it is only because no other means are available, not because no other means are better.

Like the British blockades of France, a century ago, a great blockade may be established as a means of defence, as a screen behind which the national commerce may develop in comparative safety and armies pass upon their occasions. Or, as was the case in our Civil War, the blockade may be an offensive measure, throttling the enemy's communications, cutting off his supplies and hindering his military movements.

During the Civil War the navy had two principal fields of work, one was the blockade of the coast, cutting all the oversea communication of the insurgent territory and armies, and the other was

the opening of the Mississippi. Really it should be called the closing of the Mississippi, for the reason that the States west of the river were never seriously attacked, but they sent all manner of supplies, both men and material, to aid in driving back the Northern armies. The entire effort of the navy in this region and a great part of that of the army was devoted to cutting this line of communication, after which the navy kept it closed while the western armies concentrated before Chattanooga and marched through Georgia.

Both these great efforts of the navy during the whole four years had only two principal objects, namely, to facilitate the advance upon Richmond, and the western march to the sea. One great eccentric effort was made during this time, to capture Charleston; it was undertaken solely as a political revenge upon the birthplace of secession and, being without a sound military object, the operations failed until in due course of time they were embraced in the plans of the great march to the sea.

The first great naval attack in the Civil War, in point of time as well as in the development of methods, was that upon Port Royal in November, 1861.

The Secretary of the Navy, in his report for 1861, says:

> It was found that naval stations and harbors of refuge during the tempestuous seasons would be indispensable if hostilities were to be continued, and the stations thus secured could also be made the point of offensive military operations. . . . Two combined military and naval expeditions have already been organized and put in action. Such cooperation and concert of action between the two arms of the service were indispensable; for, although the navy alone might assail and capture batteries in some positions, it was not within its province or power to retain or garrison them.

After mentioning Admiral Dupont as having been selected to command the naval part of the combined expedition to seize an important base south of the Chesapeake the Secretary continues:

> Informed of the policy and views of the government in regard to the expedition, prompt to execute its wishes, and having made himself familiar with every eligible port on the Southern Atlantic coast, he, as commander of the expedition, was intrusted with the selection within prescribed limits of the place where the first assault should be made.

The network of inland water-ways along the coasts of the South Atlantic States made it very difficult for the blockading force to operate efficiently. This first combined expedition primarily was

intended to seize a harbor as a port of refuge and base of supplies for the blockading fleet, and secondarily, it was hoped that by active cooperation between the army and navy it would be possible to advance upon the defences of the principal cities and cut their communications, after which the cities would be occupied, and the blockade would be very easily conducted by small forces operating within sheltered waters, while the ships released would be available elsewhere.

The expedition was assembled in October, 1861, in Hampton Roads, and sailed on October 29 for a destination which was not finally settled upon until after departure. The Southern government knew as well as the commander-in-chief the ports to which his instructions limited his choice, and preparations for defence had been made at all of them.

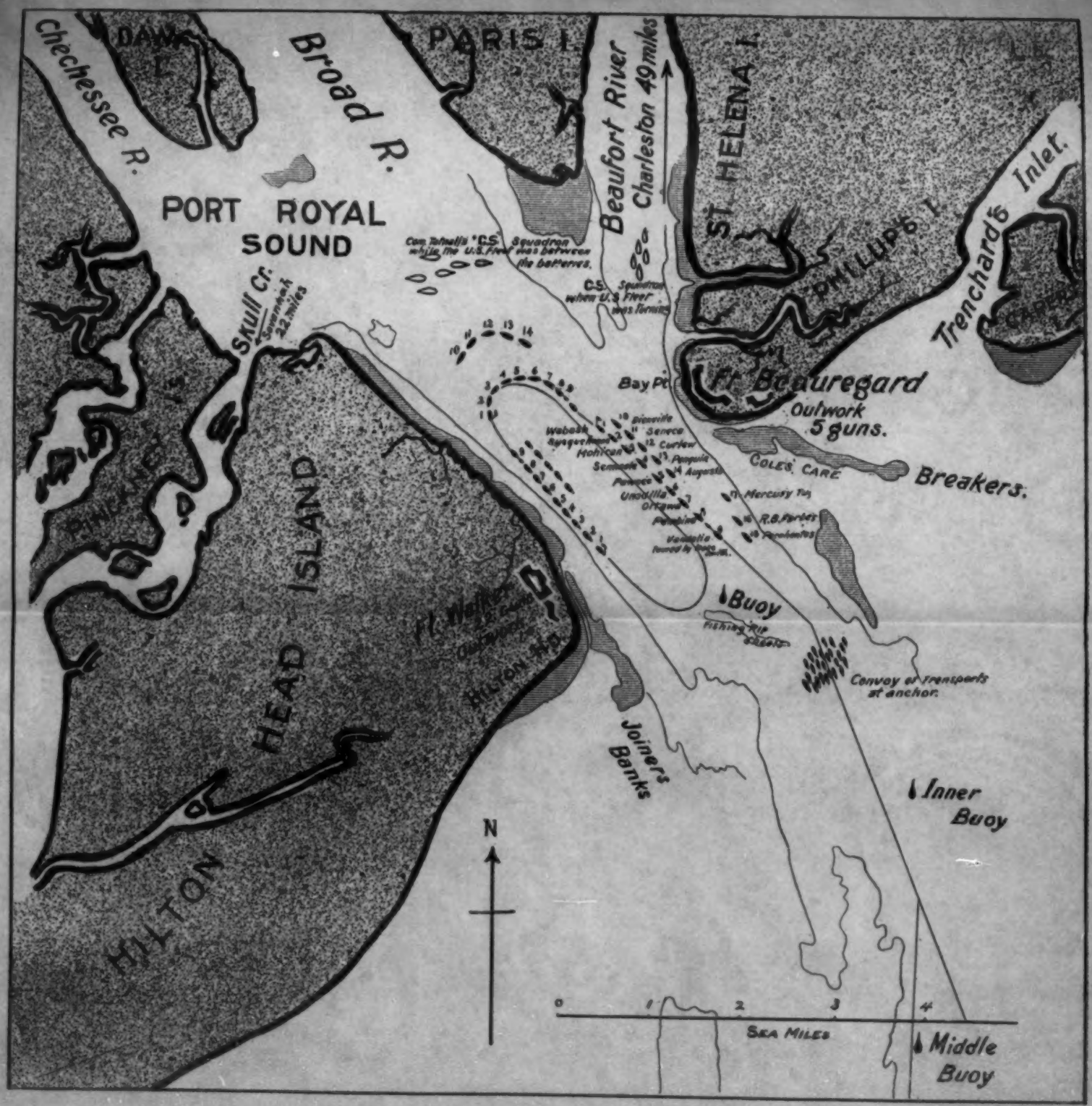
On the part of the navy the expedition consisted of two large steam frigates, three sailing frigates, five sloops of war, six large gunboats and several despatch boats. Besides there were twenty-five colliers to establish a coal depot after seizing the base.

The military part was commanded by General T. W. Sherman with 15,000 men, embarked on thirty-two steamers. After very rough weather the greater part of the transports arrived off Port Royal which Dupont had decided to attack, being led to prefer it to neighboring ports on account of the greater depth of water there available.

The fleet, dispersed by a gale, anchored off the Port Royal Bar all through the day of November 4. All aids to navigation had been removed and the bar was ten miles out at sea with no prominent land-marks visible.

By the afternoon the channel had been sufficiently examined and marked to send in the lighter transports and the gunboats, and before dark the former were at anchor in the roadstead three or four miles below the batteries, while the gunboats chased two or three hostile gunboats to shelter.

The following morning a reconnaissance by several gunboats again drove back the hostile gunboats and the distant fire from the forts showed that they were formidable works. At high tide the heavy ships crossed the bar. The work of planting buoys as guides for maneuvering in the strong tides was immediately begun but was finished too late to attack that day. On the 6th, a



CAPTURE OF PORT ROYAL FORTS, NOVEMBER, 1861

ST. HELENA I.
Beaufort River
Broad R.
PORT ROYAL SOUND
Skull Cr.
Coosaw R.
Beaufort
Parris I.
Broad R.

S. W. gale prevented operations. The 7th was calm and at high tide the fleet moved to the attack.

The fixed defences of the sound comprised two forts, Walker, on Hilton Head, and Beauregard at Bay Point.

Walker was armed with twenty-two guns in all.* Beauregard had four faces looking on the water and contained eighteen guns in all.† Total forty guns.

The mobile defences consisted of 6 river steamers of light construction and armament and exposed machinery.

Dupont organized his forces in two columns, the main column contained nine vessels, including the Wabash and Susquehanna and a sailing frigate under tow, and fired on a single broadside ‡ a total of fifty-nine guns.

The flanking column had five ships firing sixteen guns on a single broadside.§

The fleet got underway at an hour suiting the tide, with the flanking column on the right and passed up midchannel, opening fire at a range of perhaps 4000 yards. Having reached a point two and one-half miles north of Walker it turned to the west and countermarched close to Walker, proceeding slowly against the tide and passed it within 800 yards. On nearing Fishing Rip Shoal the fleet turned north once more and passed Fort Walker at 600 yards. The firing was continued until the 3rd passage in, when the forts' fire ceased at 1.15 p. m. The flanking squadron had orders to accompany the main squadron until the first turn, when the light squadron was to drive off the hostile force afloat and then take up a position close in shore to enfilade Fort Walker.

*Sea face: two 6-inch rifles, six 32-pdrs. M. L. S. B., one 10-inch Columbiad, one 8-inch Columbiad, three 7-inch sea coast howitzers. Left flank: one 32-pdr., one 42-pdr. sea coast howitzer not mounted. Right flank: three 32-pdrs. Outwork in rear commanding shore approach: two 32-pdrs., one 8-inch heavy howitzer, two 12-pdr. siege guns.

†Five 32-pdrs., one 6-inch rifle, five 42-pdr. sea coast guns, one 10-inch Columbiad, one 8-inch Columbiad. Left flank: two 24-pdrs. Right flank: three 32-pdrs. Within the fort were two 6-pdr. field pieces.

‡Five 11-inch guns, two 10-inch, twenty-one 9-inch, seventeen 8-inch, twelve 32-pdrs., and two 20-pdr. rifles, besides some smaller ones.

§One 11-inch gun S. B., one 30-pdr. rifle, one 20-pdr. rifle, thirteen 32-pdr. S. B.

The flanking squadron was particularly instructed to see that the Confederate gunboats should be prevented from slipping out in the smoke and attacking the transport fleet. These light craft withdrew at first, but came out as the main hostile column turned south, but on the return of the column they allowed a heavily-armed gunboat to drive them into Scull Creek.

The fire of Fort Walker was directed rather high and most of the hits were aloft. The ships also fired high, many shells were found far inland. Three guns only were disabled. After it was seen that the garrison was leaving Fort Walker a party was sent ashore with a flag of truce, and at 2.20 this party hoisted the United States flag on the fort. Fort Beauregard had received a distant fire from the ships and near sunset it was seen to be abandoned.

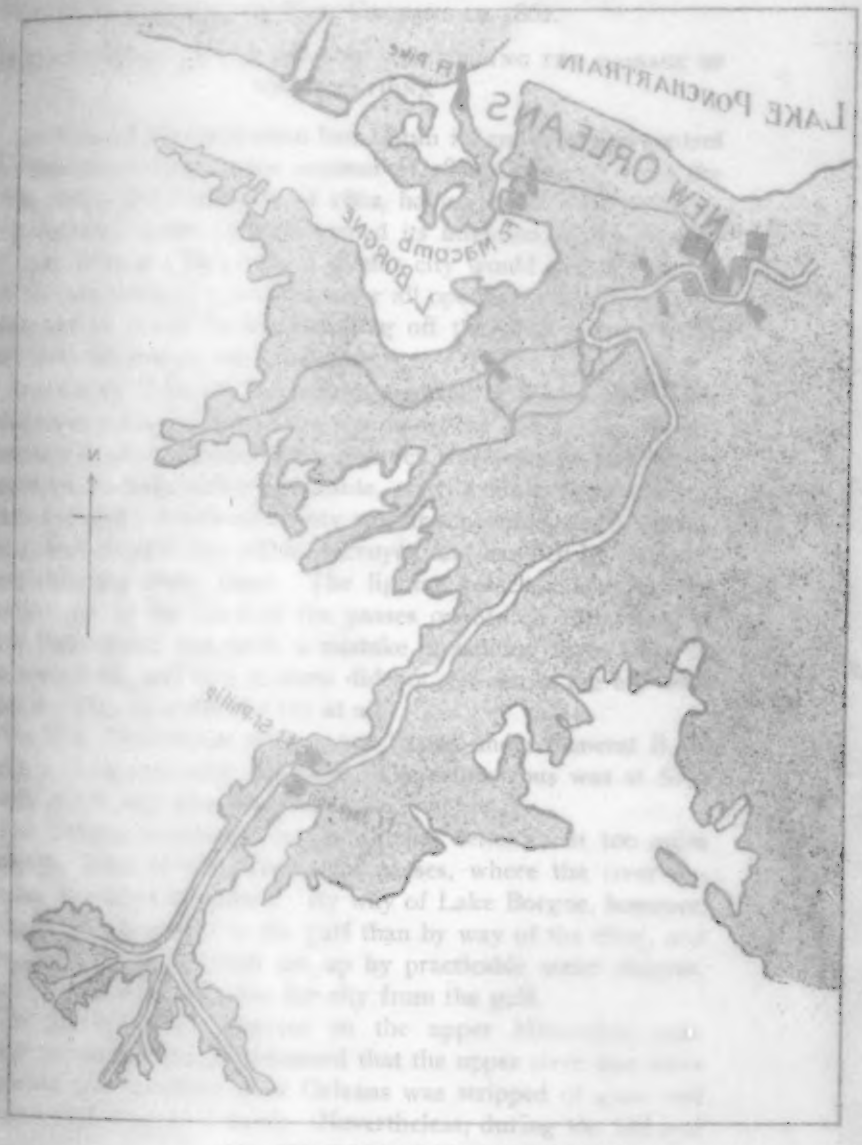
The army then disembarked and garrisoned the forts. No effort was made to cut off the retreat of the garrison of Fort Walker by sending gunboats up Scull Creek, the reason apparently being that the Admiral assumed that he would be too late; whereas the garrison did not get off the island till 1.30 a. m. of November 8 and then only by the help of the Confederate gunboats.

It appears that the original plan of attack was to land the army on the beach and make a combined attack, but the gale on the way down destroyed the means provided for disembarkation so that the navy made the attack alone.

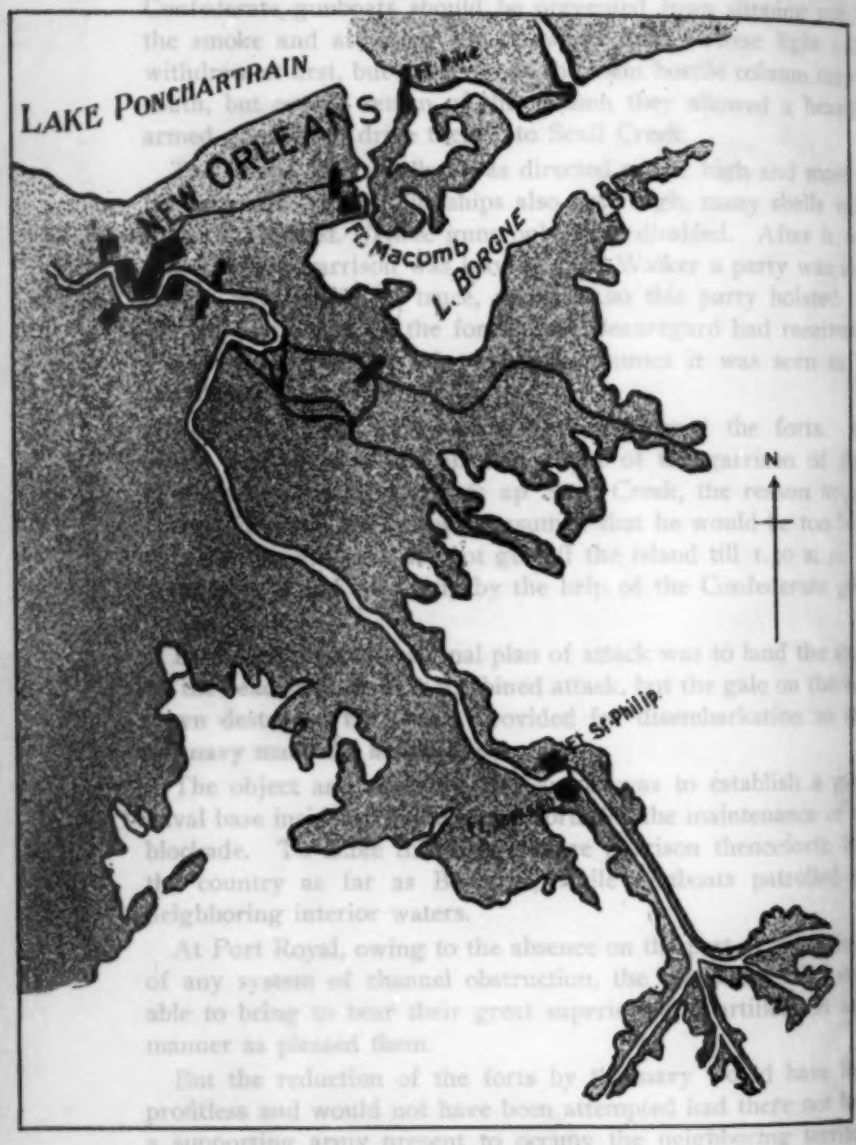
The object and result of this action was to establish a great naval base inside of the captured forts for the maintenance of the blockade. To make this safe a large garrison thenceforth held the country as far as Beaufort, while gunboats patrolled the neighboring interior waters.

At Port Royal, owing to the absence on the part of the defence of any system of channel obstruction, the attacking ships were able to bring to bear their great superiority in artillery in such manner as pleased them.

But the reduction of the forts by the navy would have been profitless and would not have been attempted had there not been a supporting army present to occupy the neighboring territory and render the harbor available as a base for a far-reaching system of blockade.



CAPTURE OF NEW ORLEANS, 1862.



CAPTURE OF NEW ORLEANS, 1862.

The Passage of Forts Jackson and St. Philip and the Capture of New Orleans in 1862.

An examination of the reasons controlling the passage of fortifications.

The Federal administration had begun its endeavors to control the Mississippi river in the summer of 1861, operating from the Ohio; and in the beginning of 1862, having established an effective blockade of the Gulf, it turned its attention to the capture of New Orleans. The control of this city would give a railroad and commercial centre, as a base for all operations further up the river, and so would facilitate cutting off the southwestern territory from the rest of the Confederacy.

Accordingly Admiral Farragut assembled at the mouth of the Mississippi a force of five large sloops of war and nine gunboats, mounting in all 154 guns,* among which were enough pivot guns amidships to make either broadside, at will, ninety guns strong. There was also a flotilla of twenty mortar schooners, each carrying one 13-inch mortar, the whole convoyed and handled by six gunboats carrying thirty guns. The lighter vessels, including the mortars, got to the head of the passes on March 18th, but the Navy Department had made a mistake in sending three ships of too great draft, and two of them did not get across the bar until April 8. The other did not try at all.

The War Department sent 15,000 troops under General B. F. Butler to cooperate with the fleet. The rendezvous was at Ship Island, which was also the naval base.

New Orleans is situated on the alluvial delta, about 100 miles above the head of the Mississippi passes, where the river debouches in several directions. By way of Lake Borgne, however, the city is much nearer to the gulf than by way of the river, and the country below is much cut up by practicable water courses, facilitating an advance upon the city from the gulf.

The operations in progress on the upper Mississippi convinced the authorities at Richmond that the upper river was more important and therefore New Orleans was stripped of guns and troops which were sent north. Nevertheless, during the fall and

*Thirteen 11-inch S. B., two 10-inch S. B., eighty-four 9-inch S. B., twenty-three 8-inch S. B., eight 32-pdrs., one 100-pdr. rifles, three 80-pdr. rifles, one 50-pdr. rifle, sixteen 30-pdr. rifles, three 20-pdrs.

winter of 1861-62, much was done by the local military and naval authorities to strengthen themselves. The plan of works adopted was to have an interior line of entrenchments around the city of about eight miles in circumference. This was for opposition to land attack. An outer cordon of forts combined with passive channel obstructions of various kinds was intended to prevent the enemy from getting its army by the help of light craft through the marshes and interior waterways surrounding the city. The main defences of the river itself were at Planche-mine Bend, about twenty miles above the head of the passes. This situation was the furthest below New Orleans at which it was possible to erect fortifications, but the river had built up its delta for many miles beyond into the gulf, so that troops might easily be landed on the shore and pushed across to the river just above the forts by a short march.

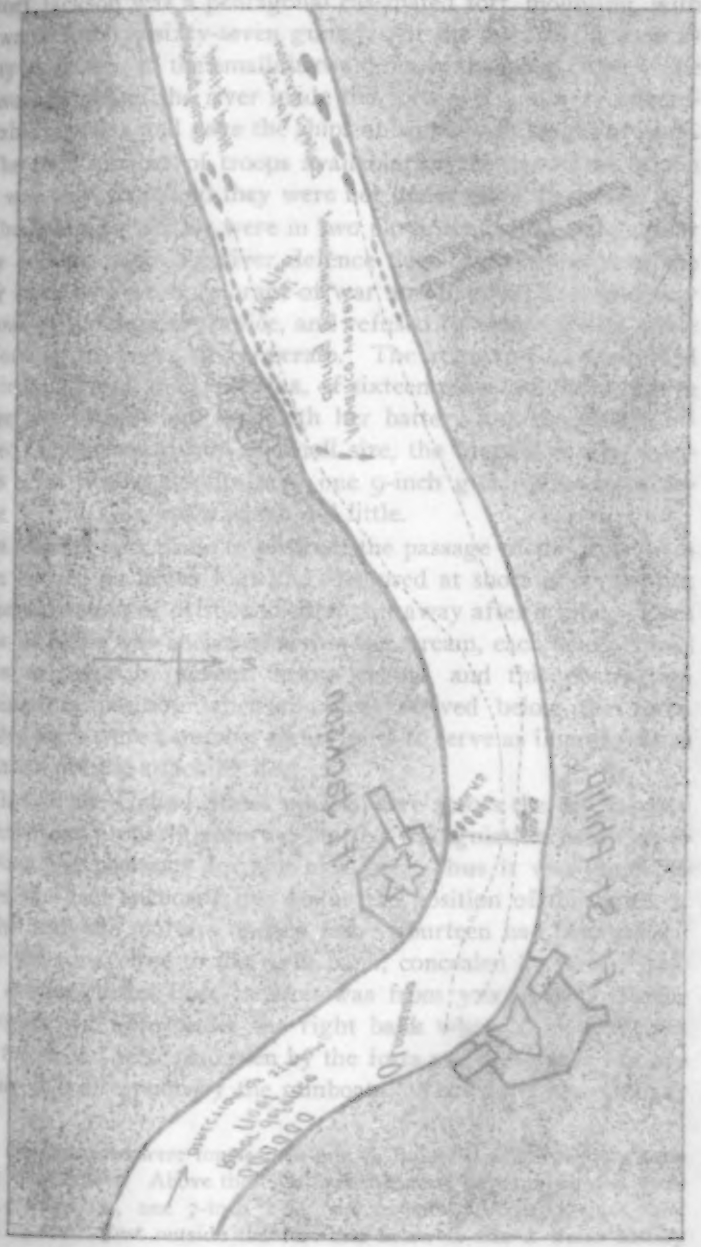
Any advance of an army from this point upon the city would be necessarily confined to the narrow strip of high land bordering the levees, and therefore the Confederates provided a fleet of ironclad ships and river boats converted into gunboats to maintain communications with these forts and aid them in their resistance to a hostile fleet and to prevent any army from occupying and marching along the river banks.

As the attack was delivered by way of the river, it is not needful to refer further to the defences in the other directions upon the minor waterways except to point out that they were a necessary part of a well considered defence; as is shown by the fact that the English army approached the city from Lake Borgne in 1814. The defences at Planche-mine Bend consisted of two permanent works, Fort St. Philip on the left bank and Fort Jackson on the right bank.

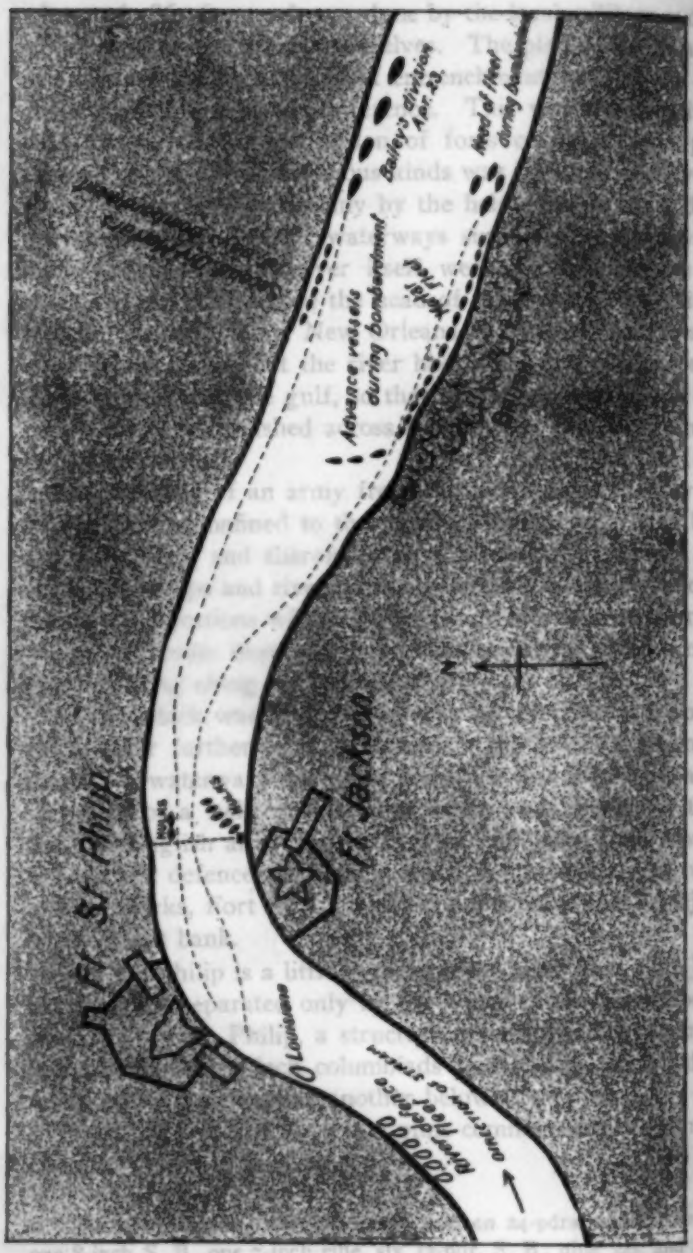
Fort St. Philip is a little higher up the river than Fort Jackson but they are separated only by the width of the river, about 800 yards. Fort St. Philip, a structure of earth and brick, mounted in barbette four 8-inch columbiads and one 24-pdr., and had a water battery above and another below it.

In all the fort had forty-two guns commanding the turn in the river.*

* The upper water battery mounted sixteen 24-pdrs. and the lower one one 8-inch S. B., one 7-inch rifle, six 42-pdr. S. B., nine 32s. and four 24s. There were also seven mortars of 8-, 10- and 13-inch caliber whose services amounted to nothing.



Passage of Mississippi River, 1862.



PASSAGE OF MISSISSIPPI FORTS, APRIL, 1862.

Fort Jackson was a pentagonal casemated fort, mounting, with its water battery, sixty-seven guns.* Of the guns in Jackson as many as sixteen of the smallest could not bear on the river. The unusual height of the river made the forts wet and very uncomfortable quarters and gave the ships an equality in height of guns.

The total number of troops available for the denfences of the city was only 3000, and they were not under good discipline.

The floating defences were in two parts, that under the regular navy and the so-called river defence fleet organized among the river men, who were ignorant of war and of discipline, intensely jealous of the regular service, and refused to accept orders while professing readiness to cooperate. The regular force included one ironclad ram, the Louisiana, of sixteen guns, not able to move under her own steam, and with her battery not completely installed; one ironclad ram of small size, the Manassas, four gunboats with twelve 32-pdrs. and one 9-inch gun. The river defence fleet had six boats which did little.

An attempt was made to obstruct the passage of the river by a chain carried on heavy logs and anchored at short intervals, but the accumulation of driftwood carried it away after a time. Then a row of hulks was anchored across the stream, each being bound to its neighbor by several heavy chains, and this obstruction remained in position when the fleet arrived below the forts. Besides there were a number of fire rafts to serve as illuminants as well as to fire the attacking fleet.

After all the United States vessels were across the bar, a party of surveyors properly escorted started triangulation in order to establish the positions for the mortars. Thus it was April 16 before the fleet anchored just below the position of the mortars. On the 18th the mortars opened fire. Fourteen had been placed below the turn, close to the right bank, concealed by trees where their distance from Fort Jackson was from 3000 to 4000 yards. The other six were under the right bank where they could see their target but were also seen by the forts and received a hot fire in spite of a diversion by the gunboats. That night they moved

* In the casemates were fourteen 24-pdr. S. B. and ten flanking howitzers of the same caliber. Above these, in barbette, were two 10-inch and three 8-inch columbiads, one 7-inch rifle, six 42-pdrs., fifteen 32-pdrs. and eleven 24-pdrs. Just outside the fort and below it was a water battery with one 10-inch, two 8-inch and two rifled 32-pdrs.

to the other shore, and the bombardment was continued for several days. As the forts maintained a return fire the gunboats took turns in sallying around the bend, firing a shot or two and dropping back before there was time for the forts to change target. Still they received some damage and one mortar boat was sunk.

The chained hulks in the river constituted an obstruction which the ships could not force in their passage up stream and two gunboats were detailed to destroy it. Their masts were removed and at 10 p. m., April 20, under cover of a very heavy mortar fire, they proceeded up the river. A heavy fire was opened on them from the forts, each grappled a hulk with the intention of destroying it by petards, but one tore adrift by the current and the other did not work her electric wires properly and broke them. A second attempt being made by one of the boats, she slipped the moorings of one of the hulks but went aground herself close under the fort. Her consort pulled her off and she then ran above the obstruction and turning, charged it at full speed with the current. The chains snapped between the third and fourth hulks from the eastern shore. In the morning it was seen that the line of hulks was greatly disturbed, leaving a broad open space.

The Confederate military authorities now wished to have the Louisiana, with her powerful armored battery, take up a position below the fort to attack the mortars, but her captain refused, preferring to try to complete his ship before putting her under fire. The army and navy had been on good terms hitherto, but this divergence of views caused very bitter feeling, although it probably had little effect on the operations. The river defence fleet also did not cooperate well in sending down fire-ships, sending one at a time instead of several at once, and handling them badly in other ways. On the night of April 23, Admiral Farragut sent a pulling boat to reconnoiter the obstruction and found it had not been renewed and at 3.30 a. m. of the 24th the fleet started up, covered by the fire of the mortar vessels and the gunboats attached to them.

The fleet was in column in two divisions; the first division was to keep on the St. Philip side and the second division following was to keep on the other side. The forts opened fire as the leading ships passed the line of hulks, the fire-rafts were kindled and the Hartford, flagship, leading the second column, crossed the river and went aground in her effort to avoid a fire-raft.

Thereupon the tug handling it pushed it against her and kindled the Hartford, a shot sunk the tug, the current carried off the fire-raft and the fire party extinguished the fire on board, so the flag-ship backed off the shoal and proceeded on. The Brooklyn, second ship in the second column, fouled the next to the last ship of the first column and ran into the hulks, broke through them, but lost her way and suffered heavily under the fire of the forts while getting her head up-stream once more. The ram Manassas, which had previously rammed another ship, now struck the Brooklyn but failed to deliver a blow quite hard enough to sink her. The last three ships failed to get by, one being disabled and the other two fouled the obstructions.

The Louisiana above Fort St. Philip added her fire to that of the forts. Above the forts the fleet fell in with the hostile gun boats and a running fight followed in which one Federal gunboat was sunk by ramming, while by sunrise nine Confederates were seen to be destroyed and two had found shelter under the guns of the forts. The Confederate naval craft had fought well, but the river defence fleet, in spite of its boasting, had done nothing.

The fleet anchored five miles above the forts and on the 25th proceeded up to New Orleans, leaving two gunboats at that anchorage to protect the approach of the army, which landed from the Gulf outside at the nearest point to the gunboats.

The ships ran by the batteries of the inner line of defence without any difficulty and, anchoring off the city, they controlled all its approaches, as the river was up to the top of the levees, so that the ships commanded the narrow strip of high land between the river and the marshes.

Below, at the forts, the bombardment was renewed, but as Commander Porter was unaware of the Louisiana's disability he feared to retain his mortar schooners and sent them outside to blockade the exits of the bayous and to assist in disembarking the army. The gunboats remained to deal with the Louisiana. On the night of the 27th, the garrison, realizing that it was cut off from the city and helpless, declined to prolong its resistance and mutinied. On the following day the forts surrendered, leaving General Butler free to occupy the city.

The forts had suffered little by the bombardment and surrendered only because the loss of communication with the city was fatal.

In this attack, we see the defence attempting an active naval counter attack upon the hostile fleet by auxiliary craft, fire-rafts, before the naval assault was begun. It was not a strong blow, but the appearance of a counter attack directed against the ship herself and not against the crew's lives is noteworthy.

Moreover, although the navy held the center of the stage, so to speak, yet it was essential to have present a strong military force to effect a junction with the fleet after it had passed the forts so as to cut them off from the city. The accomplishment of this junction of the forces afloat and ashore, with its consequent isolation of the forts, was the sole yet ample justification for running by them.

A day or two later, the presence of the fleet off New Orleans threw the town into panic and caused it to be evacuated by its garrison, but really the navy was helpless to control matters, until, again, the army appeared and occupied the town under cover of the navy's guns, when the city became available to both services as a base for future operations.

Operations against Charleston, S. C., in 1862-3-4-5.

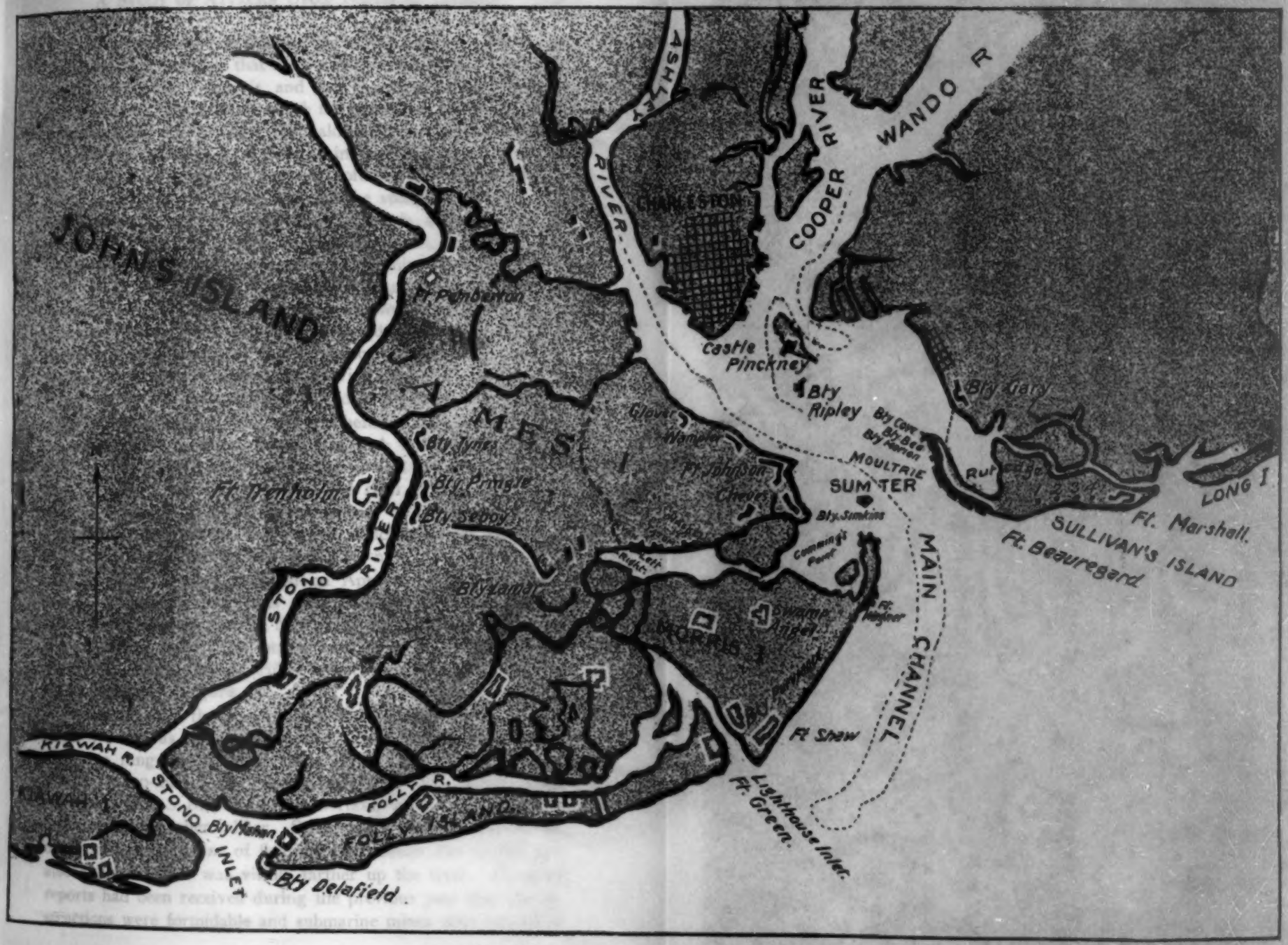
ILLUSTRATING: 1ST. A MISTAKE IN THE MEANS OF ATTACK. 2D. A MISTAKE AS TO THE KEY OF POSITION.

The blockade of Charleston was established as soon as possible after the outbreak of the war, and after the capture of Port Royal the latter point served as a base for all operations along the coast, including those against Charleston.

In the summer of 1862 an attempt was made to push troops against Charleston by way of James Island, but the attempt to open the road by the capture of Fort Lamar by assault failed and shortly after the forces withdrew. (It was by this route that the English proceeded to their siege of Charleston in 1780.)

Later in the fall of 1862, the Navy Department, inspired by the success of the navy against Port Royal and New Orleans, and anxious for political and sentimental reasons to occupy Charleston, began to make arrangements for the concentration of the new fleet of ironclads before Charleston with the expectation of easily overcoming the seacoast fortifications, and it persuaded the War Department to direct a force to aid the navy.

The Navy Department appears to have been brought to believe in the easy success of the ironclads by contemplating the facts



OPERATIONS AGAINST CHARLESTON, 1862-1865.

STONO RIVER
STONO Bl
INLET

that the wooden ships of Dupont had driven out the garrisons of the Port Royal forts and that the ironclad Merrimac had destroyed wooden ships like Dupont's, and that the Monitor had repulsed the Merrimac. From all of which the conclusion was drawn that monitors could silence forts. In making this deduction the Navy Department failed to consider that in the Port Royal fight the controlling factor was the superior volume of fire of the ships, while at Hampton Roads it was not the volume of fire but the comparative strength of armor which turned the scale. It is to be remembered that the old time wooden ships were for their period armored in exactly the same proportion as ships of to-day. That is to say, in both cases, at ranges greater than medium, the side of the ship was impenetrable to the projectiles of the day, and at Hampton Roads, light armor of the wooden ships was attacked by the heavy projectiles of the Merrimac, while their lighter projectiles were directed against her heavier armor. In such a case it is clear that success could not depend on the number of guns.

According to expectations, the fleet before Charleston was augmented by ironclad after ironclad as each was completed, and early in 1863 Dupont tried his monitors as occasion offered against Fort McAlister on the Great Ogeechee river. The results were not fully reassuring as to the capabilities of the ironclads, and Dupont so informed the Department, which, however, remained set in its wish to capture the forts by the navy.

Accordingly Dupont attacked on April 7, 1863, with seven monitors mounting two guns each, and also the armored ship Keokuk of two guns, and the New Ironsides, a broadside armored ship of sixteen guns. The total number of guns in the fleet were thirty-two—three 150-pdr. rifles, twenty-two 11-inch S. B. and seven 15-inch S. B. guns.

The forts which the fleet attacked were grouped about Sumter in such a way as to concentrate their fire upon the channel at a moderate range from all of them. They mounted seventy-six guns: ten 10-inch S. B., three 9-inch S. B., two 7-inch rifles, nineteen 8-inch S. B., ten 10-inch mortars, and others, thirty-two in number, of smaller caliber. Stretching across the channel under Fort Sumter a line of floating obstructions was visible, and also a line of piles was visible farther up the river. Frequent reports had been received during the previous year that the obstructions were formidable and submarine mines were known to

be employed in the neighborhood. Indeed one of the monitors present had been very badly injured by a mine only a short time previous.

With the prevalent belief on board that it could silence the forts the fleet advanced to the attack. As the leading vessel approached the obstruction a mine lifted her, without injury, but as the Admiral was well to the rear where his ship was unmanageable, the leading ship did not take the responsibility of passing by the obstructions, which, indeed, the Admiral had never contemplated, but swung around, heading out as it was strong flood.

After a bombardment lasting less than two hours the Admiral decided to withdraw with the intention of renewing the attack the next day. He found, however, that while the ships had lost few lives, they were very heavily racked and shaken, with turrets jammed and decks crushed by the fire they had been under, so as to require immediate repairs before undertaking further operations. The forts had fired over 2200 projectiles while the ships had fired less than 140. The forts had suffered little, but the ships were under repairs for sixty days or more.

This engagement convinced the participants that the ironclad ships could not stand up and hammer the forts into silence. Although the experience of Port Royal had taught the Confederates much about designing earthworks, it is probable that the ironclads might have depended upon their armor sufficiently to venture to run through the gap in the obstructions left for the passage of blockade runners and pass Sumter. Also, it is possible that even a fleet of wooden ships with numerous guns, such as Dupont employed at Port Royal and Farragut on the Mississippi, might have run by, depending for their success upon beating down the forts' fire by their own superior volume of fire. The two reasons why this was not attempted are very instructive, one is a tactical matter, the other concerns strategy and diplomacy.

1st. After passing Sumter the ships would have found themselves in the center of the inner circle of fire from the upper forts and there would have been no place for stopping until they had passed the city and gone some miles up the Cooper river. Here they would have been cut off from supplies of coal, provisions and ammunition, because their army support was operating on the beach on the other side of the city, and could not cover their communications with the sea. As the ships could not be

stripped of their crews to occupy the city, nothing could have been done except run out again before the coal and ammunition should be totally exhausted.

2d. If in passing either way a ship or two should have been sunk, or abandoned after grounding under fire, and afterwards recovered by the defence, the efficacy of the blockade would have been impaired seriously, and the blockade was the point in regard to which the unfriendly feeling of Europe found its best diplomatic ground of interference. It was therefore unwise to run by the forts unless the army should also have established itself behind the outer forts.

It seems from all the evidence available that the key of the defences of Charleston lay at Fort Johnston and that James Island was not very strongly held at this time. The army, based on Stono Inlet, had been ready to move on Morris Island with its right flank supported by the fleet. Its proper objective was the occupation of James Island and Fort Johnson, and an attack on the city. Had this been carried out successfully, and a few heavy ships gotten by Sumter, or even a few gunboats brought along with the army, their communications would have been secure, while Sumter and Morris Island would have been cut off both by land and water and would soon have become untenable.

After the repulse of April 7, the Navy Department fell back upon a combined attack upon Charleston and the closest cooperation was prescribed to both commanders-in-chief.

The unreasonably high opinion which every one except the officers of the ironclads continued to retain of their capabilities led General Gillmore, whose base was on the Inlet, to prefer an advance upon Sumter by the difficult way of Morris Island, where the ships would aid him by forming an advanced right flank, rather than by the easier way over James Island where he would have less spectacular aid from the navy.

The army waited two months for the fleet to repair and another month while Admiral Dupont in sulky anticipation of being relieved from duty refused to commit the navy to any plan of attack which might not commend itself to his successor. During this delay the opportunity on James Island passed away, its defences were improved, the forts inside of Sumter as well as that fort itself received additional guns and were strengthened. And besides, the torpedo defences of the channel were greatly improved.

Finally, in the latter part of July, 1863, General Gillmore began a siege of Fort Wagner. Batteries of enormous rifled guns were established and opened fire, while the fleet lent its cross fire from the sea, and the parallels were gradually advanced. After nearly two months' (fifty-eight days') work, including twenty-five bombardments by the fleet, Wagner's powers were very little injured, but the head of the sap had been pushed into the ditch of the fort, and it was evacuated by the help of the Confederate shipping which was in complete control of the interior waters. Although it had been evident for some time that Wagner could not be maintained and did not cover Sumter from bombardment, yet its defence was prolonged to occupy the Federals while the works on James Island were strengthening.

During the siege operations against Wagner it had been found possible to bombard Sumter also from the batteries before Wagner, and it was gradually reduced to ruins so that it was silenced on September 1, about two weeks after General Gillmore first opened on it. In this bombardment the ironclads also joined. At this date, September 1, Fort Sumter had lost its offensive value, but was retained as an infantry post to watch and preserve the channel obstructions against boat attack.

During the summer and fall the increase in the activity of naval auxiliary craft is very noticeable. The Federal ironclads bombarded only when supported by the siege guns on shore, and the Confederate ironclads did not undertake anything at all, but both sides sent out picket boats, and the Confederates began to use spar torpedo-boats, and submersible torpedo-boats, and contemplated night-boarding attacks by boats.

The Federals protected themselves by picketing, by net obstructions encircling their ships and by shifting their positions after dark, and attempted on the night of September 8 to assault Sumter, now without heavy guns, by a boat expedition. As the enemy had read the preparatory signal made during the day, they easily repelled the attack, as there was no surprise and some of the boats lost their way. Besides, knowledge of the most favorable point of attack was lacking to the assailants.

After the capture of Wagner and the north end of Morris Island the Federals established new batteries to be used against the remaining harbor defences, but active operations did not begin again till the end of October. About the middle of October three

heavy guns were remounted in Sumter. The calcium light was used about this time by the Federals at Cummings Point to detect the issue of torpedo-boats. The bombardments of Sumter, and boat operations against the mine fields, answered by torpedo-boat attacks on the blockading fleet, continued till General Gillmore was succeeded by General Foster in May, 1864. The monitors and Federal forts could not operate successfully against Sumter and the forts on Sullivan's Island, because the channel prevented siege works from being advanced against them. General Foster at once consulted with Admiral Dahlgren in regard to a change in the plan of the combined operations. He suggested advancing by the Stono river and James Island, or else transferring the army to the north side of the entrance, getting in rear of Sullivan's Island. It was decided to attempt to get possession of Fort Johnson and Battery Simkins on the James Island shore of Charleston harbor. If successful, the Federal forces would control the key of the whole position. It was the way the English had gone in 1780, although they went further and got behind the city. The plans for this operation involved five parts: (1) The navy was to attack Battery Pringle on the Stono river. This fort supported the right flank of the powerful lines across James Island. (2) A body of 5000 men was thrown on John's Island, and (3) 2500 were landed on the southern part of James Island to move north and entrench in front of the Confederate lines. (4) At the same time an expedition moved by the North Edisto to cut the Charleston and Savannah R. R. These operations were undertaken on July 2, 1864, with the object of inducing the Confederates to weaken the garrison of Fort Johnson in order to hold strongly their southern line of works.

That night 1000 men left Morris Island in boats to get on the beach east of Fort Johnson, land and assault the fort. The expedition delayed until day revealed it, and then it was badly led and failed. Eight days fighting took place on the part of the combined forces; the monitors, gun and mortar boats operating against Fort Pringle, but they could not silence it and a bridge prevented the ships from passing above the battery and covering the army's passage of the river in rear of the lines, so that the attack on the river side of James Island failed as well as that on the harbor side.

Finally, the Federals decided to withdraw. Another boat

attack was made upon Simkins but failed. The bombardment of Sumter continued during the summer and fall of 1864, but after September it was desultory, and the determination of the administration to attack Fort Fisher, caused it to assume an inactive policy before Charleston.

But the advance of a great western army to Savannah and its subsequent movement through the Carolinas brought about the evacuation of Charleston in a rational and unspectacular way. As soon as Sherman threatened the railways into Charleston its garrisons were withdrawn and its resistance of three years and a half collapsed, and the city was evacuated on February 17, 1865.

In this campaign we see the evils of a lack of understanding of the problem.

Admiral Dupont informed the Navy Department in the fall of 1862 that an army of 25,000 men moving by way of James Island was necessary for cooperation with him in the capture of Charleston, but the Navy Department had been swept off its feet by the popular enthusiasm aroused by the success of the Monitor in Hampton Roads and foolishly refusing to listen to the responsible professional opinion of the commander-in-chief of its choice, it insited upon a naval attack alone. When its plan failed and it persuaded the War Department to devote a small force to cooperate with the navy it still did not fully understand its problem, nor did the general commanding the troops.

In order to rest his flank upon the ironclads General Gillmore selected a line of advance along the beach of Folly and Morris Islands instead of moving directly upon the military key of the situation at Fort Johnston. In this decision he was probably misled by the belief that the newly-invented ironclads were so powerful that they would affect the fundamental principles of war, and he failed to perceive that the military key was just where it had been in 1776, when the English attacked Charleston in front, and failed; and in 1780, when they attacked by way of James Island and succeeded.

Operations against Mobile, 1864-65.

In 1862, after New Orleans had been taken, Admiral Farragut urged the Navy Department to let him proceed to Mobile and attack the forts there, so that this very important harbor might be closed to the Confederates. The Department just then was

more anxious to control the Mississippi by making a junction between Farragut's force and the squadron on the upper part of the river, and to make this ill-timed and unsuccessful attempt before it was possible for the army to cooperate, the enterprise against Mobile was delayed until the Confederates had built an ironclad force, which required the Federals to attack with ironclads. When the latter were ready the Navy Department's policy was to direct its new monitors upon Charleston, so the attack on Mobile had to wait till 1864.

Mobile was at this time, early in 1864, the only important harbor in the gulf open to the Confederate armies in the field; for although Galveston and Sabine Pass were also held by the Confederates, yet they were of little value owing to their position west of the Mississippi river, which was now controlled by the Federals.

It had been the desire of General Grant after the Chattanooga campaign to move against Mobile, and had he had his way the forces employed early in 1864 upon the unfortunate Red river expedition would have been sent to Mobile. Such a movement would have been made to cooperate with the great operations about Atlanta and Richmond, by controlling the railroads out of Mobile and by reaching out to join the army at Atlanta, thus dividing the Confederacy again as had been done by the seizure of the Mississippi.

The eccentric movement of the Red river expedition delayed even the minor operation of reducing the Mobile Bay entrance forts, since no troops were available to cooperate with the navy until the end of July, 1864.

By the time the Red river expedition was terminated Atlanta had been captured and the march to Savannah had been decided upon. The movement upon Mobile, therefore, was not, as Grant had hoped a year previously, a step in a series of grand military operations such as the seizure of New Orleans had been, but, although an isolated achievement, it was nevertheless one of great importance, putting a stop to all serious blockade running on the gulf and crushing the enemy's hopes of an offensive movement by ironclads.

Captain Mahan describes the situation as follows:

> The city of Mobile is itself some thirty miles from the Gulf, near the head of a broad but generally shallow bay, which bears the same name.

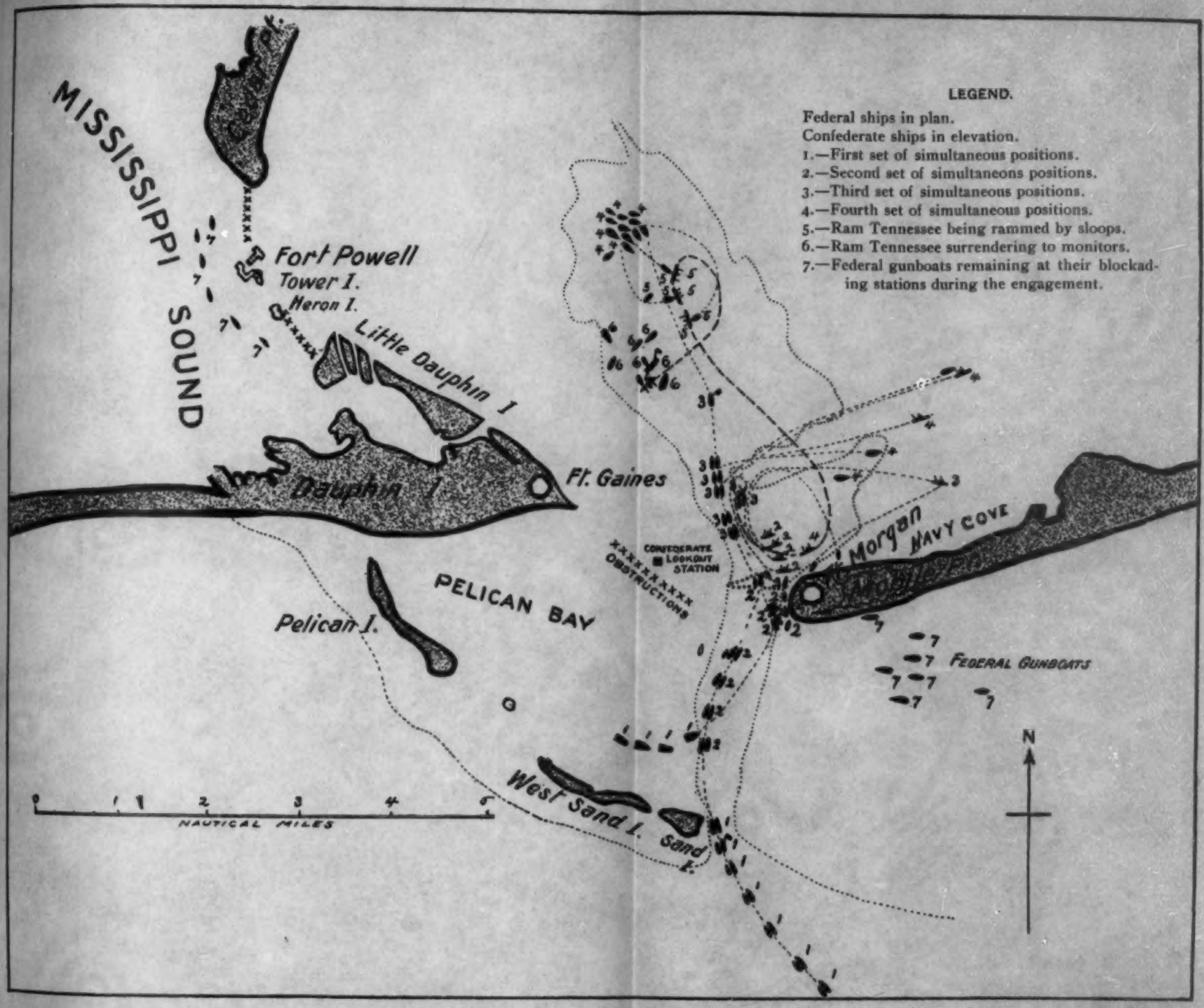
The principal entrance is between Mobile Point, a long, narrow, sandy beach which projects from the east side of the bay, and Dauphin Island, one of a chain which runs parallel to the coast of Mississippi and encloses Mississippi Sound. At the end of Mobile Point stands Fort Morgan, the principal defense of the bay, for the main ship channel passes close under its guns. At the eastern end of Dauphin Island stood a much smaller work called Fort Gaines. Between this and Fort Morgan the distance is nearly three miles, but a bank of hard sand making out from the island prevents vessels of any considerable size from approaching it nearer than two miles. Between Dauphin Island and the mainland there are some shoal channels, by which vessels of very light draft can pass from Mississippi Sound into the Bay. These were not practicable for the fighting vessels of Farragut's fleet, but a small earthwork known as Fort Powell had been thrown up to command the deepest of them, called Grant's Pass.

The sand bank off Dauphin Island extends south as well as east, reaching between four and five miles from the entrance. A similar shoal stretches out to the southward from Mobile Point. Between the two lies the main ship channel, varying in width from seven hundred and fifty yards, three miles outside, to two thousand, or about a sea mile, abreast Fort Morgan. Nearly twenty-one feet can be carried over the bar; and after passing Fort Morgan the channel spreads, forming a hole or pocket of irregular contour about four miles long by two wide in which the depth is from twenty to twenty-four feet. Beyond this hole, on either side of the bay and toward the bay and toward the city the water shoals gradually but considerably and the heavier of Farragut's ships could not act outside of its limits.

The Confederate ironclad Tennessee, on the contrary, drawing but fourteen feet, had a more extensive field of operations open to her, and from the gradual diminution of the soundings was able to take her position at a distance where the most formidable of her opponents could neither follow her nor penetrate her sides with their shot.

The plan of the operations was the same as those which had been successful on the Mississippi, that is, a combined military and naval operation. In both cases the navy was to plant itself across the enemy's line of operations, which it could do by running the gauntlet of his guns. It then remained for the land forces either to complete the investment (of the forts) and await their fall by the slow process of famine, or to proceed with a regular siege covered by the fleet. Without the protection of the ships in the bay, the army would be continually harassed by the light gunboats of the enemy and very possibly exposed to attack by superior force. Without the troops the presence of the ships inside would be powerless to compel the surrender of the works or to prevent their receiving some supplies.

The defences of the harbor of Mobile consisted of the following fortifications:



ENTRANCE TO MOBILE BAY, AUGUST 5, 1864.

ENTRANCE TO MOBILE BAY

Fort Morgan:

10-inch S. B.	7
8-inch S. B.	3
32-pdr. S. B.	11
24-pdr. S. B.	10
8-inch rifles	2
7-inch rifles	2
6.5-inch rifles	7
30-pdr. rifle	1
24-pdr. rifle	1
3-inch rifle	1
12-pdr. howitzer	1

46 guns in all; of these 16 of the lighter guns bore on land.

Fort Gaines:

10-inch S. B.	3
32-pdr. S. B.	5
24-pdr. S. B.	2
18-pdr. S. B.	2
32-pdr. rifles	4
24-pdr. howitzers	11

27 guns in all, of which 11 bore on the land.

Fort Powell:

10-inch S. B.	1
8-inch S. B.	1
32-pdr. S. B.	1
7-inch rifles	2

5 in all, bearing on the sound and channels. The rear of the fort was unfinished.

Besides the fortifications mentioned above, a line of pile obstructions ran out from Fort Gaines to prevent light craft from passing over the shoal and a triple line of fixed mines closed the main channel from the end of the piling nearly to Fort Morgan, but a narrow passage close under the fort was left open for blockade runners. The deep water end of the mine field was marked by a buoy. Inside the forts were three wooden gunboats and the ironclad ram, Tennessee, the most formidable ship the Confederates had ever built, armed with four 6-inch rifles and two 7-inch rifles, protected by inclined armor of six inches and five inches in thickness. Her weak points were her slow speed and her lack of protection to her steering gear.

To make the attack Farragut had four monitors, mounting in all four 15-inch guns and eight 11-inch guns, and fourteen sloops and gunboats, mounting in all 161 guns from 11-inch S. B. to

12-pdrs. and from 150-pdr. rifles to 20-pdrs.; of the total of 173 guns about 100, including all the heaviest, could be fired on one broadside. The weight of fire of the ships' broadside was six times that of Fort Morgan or, as the lines were formed for the attack, it was between four and five times as heavy. Besides this attacking force two blockading divisions of gunboats of twelve ships in all remained outside, one south of Fort Morgan, the other, in Mississippi Sound, where it closed the westerly entrance to Mobile Bay.

By the end of July the final plan of the joint operations had been agreed upon between General Canby and Admiral Farragut. The first plan had been for the fleet to run into the bay and destroy the Confederate naval force and support the army, while the latter was to land and invest all three forts at once without executing any siege operations. General Canby was obliged to detach a force to protect Washington and consequently he had to reduce his share of the undertaking, so a second plan was adopted at the suggestion of the Admiral. It was decided to land the army upon Dauphin Island from Mississippi Sound under cover of the gunboats there, and August 4 was selected as the date for the army to land and the fleet to enter. One of the heaviest monitors, however, had not arrived from the north in time and the Admiral felt obliged to postpone his entrance for twenty-four hours in order to have her with him to fight the Tennessee, but a little ahead of time, on the afternoon of August 3, the army under General Granger landed seven miles from the fort and immediately invested it. The attack on Fort Gaines was thus developed by the army, but owing to the inability of the navy to enter the bay simultaneously the enemy had all of August 4 to use his shipping to reenforce Gaines with troops and supplies; an opportunity he did not fail to improve.

By the morning of August 5 the Federal engineers had six 3-inch guns in position opposite Fort Gaines and at daylight on the same morning, the fleet weighed anchor for the attack. The monitors had been lying behind Sand Island; they came out in column with orders to precede the wooden ships and pass close to the fort and take the brunt of its fire, the wooden vessels were outside the bar and formed in column also, but they were lashed together in pairs so that if one was disabled her consort might pull her through, and also that they might gain facility in ma-

cuvering. The column was formed with the heaviest ships leading. As the monitor column drew up with the fort the head of the column of wooden ships gained on it and while the two rear monitors slowed to lie by the fort and cover the passage of the wooden column, the other two were ordered to engage the Tennessee. The Tennessee and her gunboat consorts lay in line abreast, behind the torpedo line, and as the Tecumseh, the leading ship of the attack, drew close to the fort, it seemed to her captain that the passage to the eastward of the great buoy was too narrow and he was anxious to reach the Tennessee. He therefore put his helm over, crossed ahead of the other column and went to the westward of the buoy, just as the monitor was close to the Tennessee she struck a torpedo and instantly sunk. At this instant the Brooklyn leading and Hartford second ship had just brought their broadsides to bear and a tremendous fire seemed to have momentarily silenced the fort. The disappearance of the Tecumseh caused the captain of the Brooklyn to hesitate; he thought he saw a line of torpedo buoys in the fairway. He backed his engines, threw his ship across the bows of the advancing column, checking it and turning the fleet formation into a confused group with an inadequate fire, while the flood tide was sweeping every one upon the torpedoes and the fort reopened a vigorous fire.

The Admiral had caused the line of torpedoes to be examined on several reconnaissances at night and had not been able to find any, besides he did not think all would be efficient, so long had they been in the water. Therefore as the Brooklyn blocked the known safe passage, in spite of the loss of the Tecumseh, the flagship swung to port to clear the Brooklyn and took the lead, heading for the Tennessee. The Brooklyn warned the Admiral of the danger as he passed, but he made the heroic reply, become traditional in the navy—"Damn the torpedoes. Full speed." As the Hartford crossed the mine field the mines were heard rattling against her bottom but none exploded and she soon engaged the Tennessee with her starboard broadside. The other ships followed the flag, which drove the gunboats before it, while the Tennessee, after failing to ram or overtake the Hartford, turned and passed down the line of gunboats, trying to ram successive ships but unable to do so by reason of her low speed. When the last had passed the Tennessee ran under the guns of the fort. As the ships got within the bay, the gunboats cast off their heavier

consorts and pursued the hostile gunboats. One was captured on her way to Mobile, the others took advantage of the concealment offered by a heavy rain squall to swing around and anchor under Fort Morgan. As the Federal ships passed inside, Fort Gaines opened on them with two heavy guns, but the field guns placed by the besieging army during the previous night promptly silenced these.

The fleet passed safely beyond the range of the forts, and believing the Tennessee had anchored, the U. S. fleet itself anchored. Farragut announced his intention of attacking her that night with the monitors. Barely had the ships anchored when it was seen the Tennessee was coming out from the fort. Breakfast was thrown aside and the Admiral led in an attack upon the enemy. She was rammed repeatedly by the wooden ships without receiving much injury, and their shot that struck her rebounded, while her own fire caused much slaughter among the wooden ships. Meantime the monitors stuck to her very closely, firing steadily; the smokepipe was shot away, reducing her low speed still more for lack of draft to the boilers, and the continual pounding began to shake off her armor, jammed the gun-port shutters, and cut the steering-gear. When quite unmanageable she surrendered.

It may be pointed out that when the Tennessee decided to leave the shelter of Fort Morgan for a fight to the finish with a superior force, she at the time interposed between that force and a weaker detachment outside. Had the Tennessee gone outside against the gunboats there, Farragut would have been obliged to run by the forts again to save his gunboats. In short, had Admiral Buchanan grasped the entire problem of the defense of Mobile instead of thinking only of a bull-dog fight with his former comrades, the Tennessee, before sacrificing herself, could have obliged the hostile squadron, or at least a considerable part of it, to leave the bay, and thereby perhaps would have imperilled the situation of the Federal troops on Dauphin Island and certainly would have caused much additional loss to the Federal fleet. Indeed, when the Tennessee was seen to be leaving the fort and was erroneously reported to be going to sea, Farragut said he would have to follow her out.

During the entrance of the fleet, the gunboats in Mississippi Sound had been bombarding Fort Powell, and in the afternoon a monitor came up the bay and took the fort in reverse with

great effect. That night the fort was evacuated and blown up. The next day a large force was set to remove the obstructions in Grant's Pass under the guns of Fort Powell and this being done the communications of the U. S. fleet were established with its base at Pensacola.

During the 6th, Fort Gaines was bombarded by a monitor and preparations made for a general bombardment the next day. A sand ridge along the southern side of the island gave cover to within 400 yards of the fort. During the 7th, the siege works were well advanced and four heavy guns brought up, so that the combined fire from the navy and the siege batteries would have taken all the faces of the fort in front, enfilade, and reverse. Instead of bombarding, negotiations for surrender were begun on the 7th and the fort surrendered the next day, August 8.

The troops were then moved across the bay on the 9th and landed on Mobile Point in Navy Cove at a wharf found in good order. It is to be noted how much better was the plan of operations than that at first contemplated, of attacking Fort Morgan by landing on the gulf side. This was due to the success of the earlier operations in isolating Fort Morgan before besieging it. In the afternoon the troops advanced within 2000 yards of the fort and that night occupied the first parallel, about 1400 yards from the fort, putting into it the army 30-pdr. rifles and such long-range guns as the fleet could supply.

Twice a day the monitors bombarded the fort from a point north of it and distant about a mile. The second parallel was opened on August 15; the following day twelve 10-inch siege mortars arrived and on August 22, at daylight, the siege batteries of eighteen guns and sixteen mortars, and the monitors and the captured Tennessee opened fire. The fort did not reply. Fire broke out in the fort that night and it surrendered on the 23rd.

It was agreed by General Canby and Admiral Farragut that it was impossible to move on the city without more troops which were not then available and active operations were suspended for several months.

In these operations, the mutual dependence of the army and navy upon each other is very prettily illustrated, as well as the cordial agreement between the two services arising from the comprehension of each others' situation and necessities. It is to be noted as a point in tactics that, although the whole fleet

crossed the mine field, yet this was not contemplated by the Admiral in formulating his plan, and the step became a necessary risk as the only way open to the Admiral of retrieving the errors and hesitations of subordinates. As at New Orleans, the accomplishment of the junction with the army behind the fortifications, whereby their communications were cut without losing his own, was Farragut's justification for running inside. Yet he could not have staid there had the Confederate Admiral understood how to deliver his counterblow by attacking the Federal force outside, and so obliging Farragut to repass Fort Morgan in order to support his outer squadron.

The success of General Thomas at Nashville enabled reenforcements to be sent to General Canby and by the middle of March, 1865, he was ready with nearly 50,000 men to advance north through Alabama towards Montgomery, to overrun and control that State and make a junction with a force operating from the north. Most of Canby's army was on Dauphin Island and Mobile Point, but about a quarter was at Pensacola.

It was his intention first to seize Mobile and, using that city as a base, he would have the railroad as a line of supply behind him. He arranged with the navy that it should so hold the line of the Mississippi that the opposition to his operations should receive no aid from across the river. The navy was also to support him and cover his transports in their movement about the rivers near Mobile.

The city of Mobile is about twenty-seven nautical miles north of Mobile Point, at the head of Mobile Bay on its west side. The city was very strongly defended on the west side, and besides, the line of approaches on that side of the bay was low and difficult. The advance, therefore, took place on the east side of the bay. To the east of the city of Mobile, at the head of the bay, is a delta of intersecting channels formed by the streams which empty there. The entrances to these channels were very strongly defended by channel obstructions and a great many mines, in whose employment the Confederates were very skilled. On the east side were two very powerful earthworks at Blakely and Spanish Fort. The direct channel to the city was obstructed and these obstructions were supported and covered not only by the fortifications of the city but by floating batteries. As the Federal navy could bring to the neighborhood only the light river moni-

CAPTURE OF MOBILE, MARCH AND APRIL

tors, and the army could not aid it in an attack along this channel, it is obvious that a combined movement of the army and navy by the eastern approach to the city was the only practicable plan. Besides the defences mentioned above, the Confederates had three light draft ironclads and a gunboat operating in the rivers.

On the 17th of March the movement began. The army corps on Mobile Point marched by land to Dannelly's Mill, on the Fish river, about seventeen miles above its mouth. At the same time a brigade was sent to occupy Mon Louis Island on the west side and make as much of a display as possible.

On the following day as much of the corps on Dauphin Island as could be provided with transportation was shipped to Dannelly's Mill by water under convoy of the navy, and here a temporary base was established. On this day the navy reconnoitered along the east coast of the bay and shelled the country to drive out any hostile force, as well as to ascertain if any batteries had been erected there.

On the 19th, the Pensacola force also moved upon Mobile in cooperation. Bad weather now interfered with the march of the troops till the 25th, but on the 26th and 27th Spanish Fort was invested, although the movement met with sharp opposition. The Confederate ironclad was particularly annoying to the right flank of the attack and a battery was erected to reply to her.

The base at Dannelly's Mill was broken up, and a new one was established five miles below Spanish Fort and was protected by the navy from the Confederate ironclads. Wharves were built here, roads opened and the supply of the army secured.

After the 30th the fire of the batteries Huger and Tracy was diminished and the Confederate gunboats driven off by the fire of the rifled battery erected for the purpose on the bluff of Bay Minette.

The light monitors moved up towards Spanish Fort, clearing the channel as they went, but two of them and a wrecking boat were lost by torpedoes, on three successive days. On the 1st of April the column from Pensacola began to arrive near Blakely and completed the investment of that position on the 2nd of April. On the 4th of April the siege batteries opened fire against Spanish Fort.

It had been hoped that the navy would be able to get into the Blakely river and cut off the fort from the city, but the river

could not be cleared fast enough for the ships to proceed. However, the navy was able to place and man some heavy guns as a siege battery. On the 8th of April, after dark, the lines were assaulted under cover of a bombardment and Spanish Fort was secured.

The operations against Blakely followed much the same course, the Confederate gunboats giving considerable annoyance to the right flank of the besiegers. On April 3, a general assault carried the entire line at Blakely. The navy continued to clear the river of torpedoes and on the 10th it was able to shell the earthworks called Tracy and Huger. At night these works were abandoned by the Confederates and occupied by a naval garrison until the army could relieve it. The navy continued to clear the channels towards Mobile while two divisions of the army marched to the base at Starke's landing to be ferried to the other side of the bay south of the city.

On the 12th the army crossed and marched upon the front of the city, while the monitors appeared in the river in its rear, but the night previous the city had been abandoned by its garrison as the threat from two directions was one impossible to resist, and the mayor surrendered his government to the commanders of the two services.

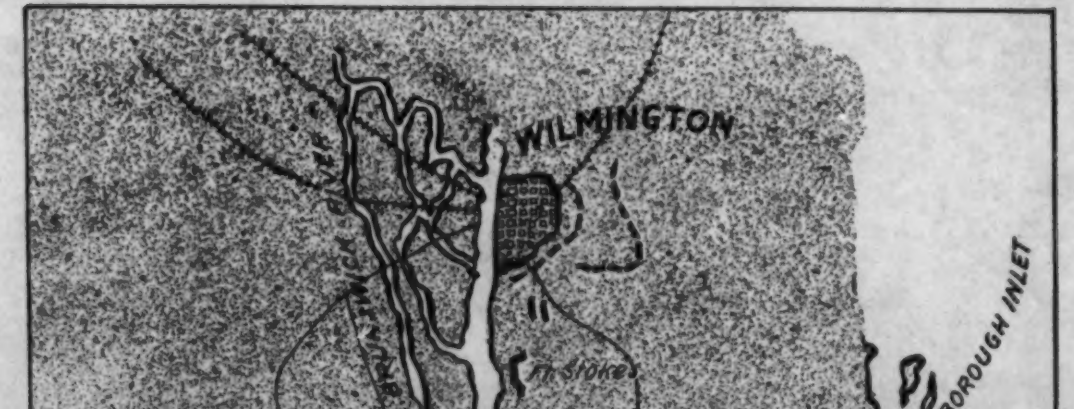
The further operations in this district until the close of the war lack instruction for us.

In the second, as in the first series of operations we are impressed by the good will and mutual support between the two services.

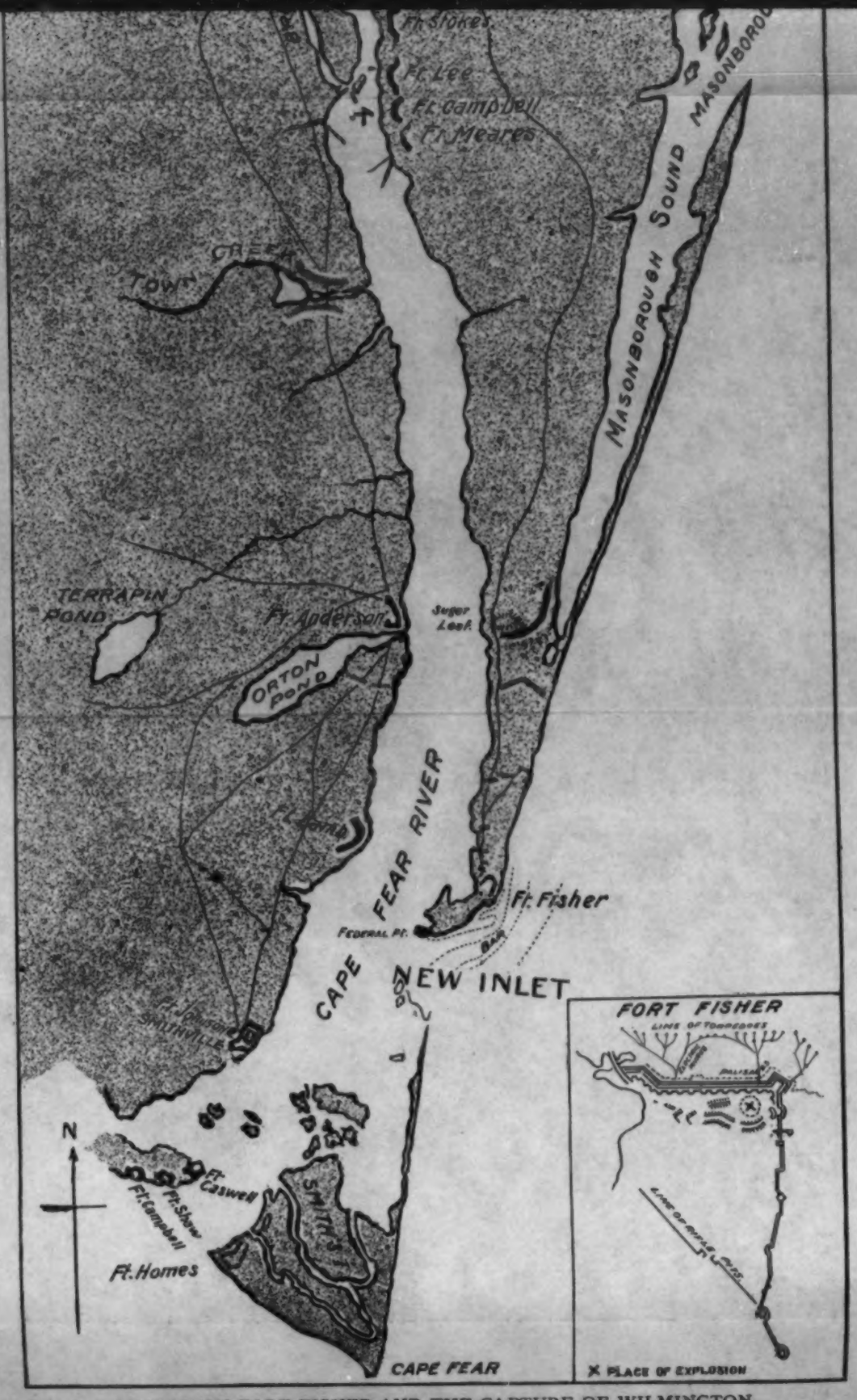
In a critical review of the campaign the prominent feature is the fact that the general plan being to establish a complete investment of the city of Mobile with the army in front of the city entrenchments and the navy in rear, cutting the water communications, it was necessary to aid the navy in its movement upon the key of the situation by the efforts of three army corps, the whole military force present, for a period of three weeks.

Admiral Thatcher had succeeded Farragut in command of the station and his attitude towards his own operations as revealed in his reports is an amusing one. He sends despatches to Washington enthusiastically telling how the army is getting on and how well the navy is doing dragging for torpedoes and clearing the channel in one place and bombarding the enemy an another,

ATTACK ON FORT FISHER AND THE CAPTURE OF WILMINGTON


WILMINGTON
Ft. Stokes
BOROUGH INLET

Ft. Stokes
Ft. Lee
Ft. Campbell
Ft. Meares
TOWN CREEK
MASONBOROUGH SOUND
MASONBOROUGH INLET
TERRAPIN POND
Ft. Anderson
Sugar Loaf
ORTON POND



ATTACK ON FORT FISHER AND THE CAPTURE OF WILMINGTON.

but he is unable to perceive the relation of each day's work to the progress of the campaign as a whole, so when he has finally reached the back of the city and finds the garrison has evacuated a few hours before, he merely regards the navy's hard work as wasted, and writes an indignant letter to the Department, implying that the enemy was too ill disposed to the National Government to give him the satisfaction of bombarding the city. He was quite unable to realize that his hard work was fruitful, although unspectacular, and that by the seizure of the military key through that work, further resistance on the part of the garrison became foolish.

Attack on Fort Fisher, 1865.

An example of successful cooperation.

Fort Fisher guarded one of the two entrances to the Cape Fear river, on which is situated the city of Wilmington, N. C.

By the fall of 1864 the Federal blockade of the southern coasts was so complete that only Charleston and Wilmington were carrying on any foreign commerce. The latter city was of great importance as the source of military supplies for the army of Northern Virginia, but owing to the unusual condition at the mouth of the river, the navy alone could not efficiently close the entrance, although from thirty to forty vessels were constantly before it. This was owing to the double entrance at Cape Fear, between which the Frying Pan Shoals extended many miles to sea, requiring two distinct squadrons to close the two entrances. Fort Fisher defended the main entrance and was so placed as to rake the ships approaching the coast from seaward by the channel through the shoals. This was an error in locating the fort, since the engineer did not fully consider the hydrographic features. The outer bar was just abreast the fort, with a deep pocket just outside, and therefore the big ships lying outside the bar could bombard at close range. Had the fort been on Federal Point, no big ships could have gotten near it.

Obstructions had been duly placed in the channel, but they were so far to the rear of the fort that there was no reciprocal support, and thus the advanced position of Fort Fisher decided the plan of operations. Upon the request of the Navy Department General Grant agreed to aid in closing the river to blockade runners.

In December, 1864, 6500 troops under General B. F. Butler were detailed and the expedition set out, and arrived off Fort Fisher on December 18. The weather was not favorable for landing on the open beach and on the 20th many of the transports had to run to Beaufort, N. C., to renew their supplies. The gale caused much confusion, but by the 23rd the weather was good and although the transports had not returned Admiral Porter thought it necessary to improve the opportunity and begin the attack. On the night of the 23rd an explosion vessel was sent in and exploded as near the fort as possible but did no damage. On the 24th the bombardment by the fleet began. At night only a few transports had arrived and the fleet withdrew out of range. On Christmas day almost all the transports were up and it was decided to land under cover of a bombardment. Seventeen gunboats were detached to cover the landing and assist with boats.

The landing began at 2 p. m., about three miles from the fort, and about 5 o'clock, when half the troops had landed, General Butler decided to return to Hampton Roads, on the ground that a reconnaissance showed an assault to be impracticable. A number of stragglers, however, actually had been inside the fort, meeting with no opposition. The weather becoming rough after dark and remaining so, it was necessary to leave 700 men on shore for two days under cover of the guns of the fleet, when they also were reembarked without incident.

Admiral Porter informed the Navy Department that General Butler's presence was the only cause of failure, and after inquiry, General Grant sent back the same troops, somewhat reenforced, with Major-General Terry in command. The total force, including two field batteries, was 9600 men. Its embarkation began at Bermuda Hundred on January 4 and was completed the following day. No horses, wagons, ambulances nor artillery caissons were taken, but 150 extra rounds per gun in packing cases were provided.

After embarking, General Terry was informed by General Grant of the object of the expedition and that a siege train of twenty 30-pdr. rifles, four 100-pdr. rifles and twenty mortars would follow immediately for use in case a siege should be necessary.

On the 6th the transport fleet sailed from Hampton Roads, and on the 8th it began to arrive at Beaufort, where the vessels needed repairs and supplies. Those vessels which entered Beaufort har-

bor could not get out till the 12th on account of high seas on the bar, but arrived that night off Fort Fisher.

At 4 a. m., January 13, the inshore division of gunboats stood close in shore between five and six miles above the fort, where Masonborough Sound and the marsh behind it prevented any opposition to landing. The transports formed a parallel line 200 yards outside and another division of gunboats took position farther north to prevent any water counter-attack by the sound. At 8 a. m. 200 naval boats were sent to aid the transports' boats, and at 3 p. m. nearly 8000 men with forty rounds of ammunition, nine days' provisions, 300,000 rounds of reserve ammunition and entrenching tools were on shore without accident except some supplies spoiled. Supplies could be landed only on an average of two days per week, owing to the weather. The opposing force consisted of 1800 men in Fort Fisher and a field force of 6000 men in observation with headquarters at Sugar Loaf. Besides there were gunboats on the river.

On landing the United States forces threw out pickets who ascertained the presence of the field force which had not been known previously. The guns of the navy prevented these troops from approching the fort and placing themselves between it and General Terry.

After dark General Terry moved along the beach to a point about two miles from the fort and threw up a line of entrenchments from the sea to the river to protect his rear. This line was defensible by 8 a. m. of the 14th. On the morning of the 14th the field artillery was landed and most of it was placed on the river end of the entrenched line, as the navy could cover the sea flank, and had been asked to do so, and also to cover the landing of the supplies on the beach. A brigade was sent towards the fort to reconnoitre and an outwork 500 yards from it was taken and turned into a defensive line. A skirmish line was advanced to within 150 yards of the fort and a line of rifle pits was dug there.

The Confederate gunboats were annoying to the U. S. troops and a battery of 30-pdr. rifles was begun on the river to drive them off.

It is now time to describe Fort Fisher. It was a very powerful earthwork with a sea face of 1300 yards and a land face of 480 yards.

The sea face mounted twenty-two guns,* and the land face had twenty-four guns.†

The very large bombproof traverses of the fort became an important feature in the assault. A loopholed palisade with banquette ran in front of the land face from sea to river and in front of the palisade was a line of ground mines electrically controlled from within the fort.

At 7.30 a. m. on the 13th, the four monitors and the New Ironsides were sent in to draw the fire of the fort to see where the guns were. The fort soon slackened fire and replied with only one gun. After the troops were ashore, the wooden ships moved to firing position about 3 p. m. and a heavy fire was maintained till after dark, when the wooden ships drew off, leaving the monitors to fire slowly during the night. On the 14th, the small gunboats with 11-inch guns were sent to attack the land face to dismount the guns there, while a rapid fire from the lighter broadside of the Brooklyn was maintained to keep the guns from being manned.

This plan was successful and under its cover the army advanced and entrenched.

By this time the Confederates had decided that for them to attack the United States troops, entrenched and covered as they were by the navy, would only lead to disaster, and that as the weather rendered the landing of supplies very uncertain, the attacking force could not wait to besiege, but must assault. Therefore, on the night of the 14th an addition of 500 men was made to the garrison by means of the Confederate navy which still preserved water communication with the fort. This gave a force of 2300 men to defend a line 500 yards long. On the afternoon of the 14th, General Terry and Admiral Porter held a conference at which it was decided that the uncertain communications through the surf rendered an assault necessary and that the navy must open the palisade the next forenoon. It was arranged also that the navy should land 1600 bluejackets and 400 marines to attack the sea bastion while the army was to attack the river bastion and sally port. The disembarkation of the siege train

* One 8½-inch rifle, one 8-inch rifle, two 7-inch rifles, five 6⅓-inch rifles, eight 10-inch S. B.. five 8-inch S. B.

† Three mortars, two 10-inch S. B., five 8-inch S. B., seven 32-pdr. S. B., one 24-pdr. S. B., one 7-inch rifle, four 6⅓-inch rifles, one 4½-inch rifle.

and also the fire of the monitors began early on the 15th and continued all day. The fleet moved in to bombard later in the forenoon and opened a very heavy fire on the fort at about 11 a. m. It numbered on this, as on the other days, about forty ships in the firing line, with about 400 guns, of which about 260 were available on one broadside.* The bluejackets with cutlasses and pistols and marines with rifles were landed in the forenoon and advanced along the beach to a point 600 yards from the fort, where an entrenchment was thrown up and afterwards a line of rifle pits was dug within 200 yards of the fort by the bluejackets and occupied by the marines. Here they were under fire of grape and musketry from the fort, and the premature explosions of shells from the fleet also annoyed them. Owing to the lack of time between landing and the hour of attack, the small parties from each ship were deprived of an opportunity of forming themselves into a cohesive organization. It was not even known who was in command until the bluejackets were about to charge, and so the leaders could not arrive at an understanding in regard to the duties of the different detachments nor communicate with General Terry in time to arrange for proper cooperation. Squadron general orders prescribed that the sailors should "board the fort on the run in a seamanlike way." The Admiral's order, dated on the morning of the assault, provided a much more rational plan, but it does not seem to have removed the impression made on people's minds by the generally circulated previous order which had been public for a day or two.

The fire of the fleet was continued till 2 p. m., at which time the fort was silenced, the palisade well opened and, as was afterwards learned, the controlling wires of the mine fields were all cut. The signal for the assault was given at 3 p. m. on the steam whistles of the fleet, and both soldiers and sailors moved to the assault. The tide being low the crest of the beach offered cover and the leaders of the bluejackets got beyond the palisade and even reached the parapet, but they had few muskets among them, and the marines did not maintain a good fire from the rifle pits, so the attack was repulsed, although a number of men remained under the palisade until dark.

*Table of fleet's guns available on one broadside: eight 150-pdr. R., twenty-six 100-pdr. R., four 60-pdr. R.; thirty 30-pdr. R., nine 20-pdr. R., ten 15-inch S. B., twenty 11-inch S. B., one hundred and twenty-eight 9-inch S. B., twelve 8-inch S. B.; thirteen 32-pdr. S. B.

During the bombardment most of the infantry of the garrison had been at a distance behind the fort, and when the assault was made the greater portion of the force was sent forward to the sea angle to repulse the sailors, the consequence was that by the time these were driven back, the army, advancing under cover of the hill and woods on the river side, had established itself on the other flank of the work. The huge traverses afforded a series of defensive positions from which the Confederates were driven successively by most desperate fighting. The fleet continued its fire upon the sea face of the fort. One of the guns on this face had been traversed and was firing grape on the assaulting force. It and some field pieces were disabled by the monitors, whose fire also shook the infantry of the defense. Finally, the defeated bluejackets and marines were sent to hold the entrenchments to the north while the fresh soldiers there were withdrawn and sent into the fort to relieve the weary troops and continue the assault. The Confederate field force attempted a diversion by attacking these northern entrenchments, but as soon as its skirmishers moved forward, a division of gunboats opened fire and restrained any further effort on its part. At about the same time the fleet shifted its fire to the beach south of the fort to prevent possible reenforcement coming across the river by way of Fort Buchanan. The new troops carried the fort with very little resistance and by 10.30 p. m. the action was over.

The following day the navy found and buoyed the channel, took up the torpedoes in it and pushed light draft gunboats over the bar. As soon as three gunboats were inside the bar the Confederates prepared to abandon Smith's Island and all the forts about the other entrance. On the night of the 16th they were blown up. The navy then took possession of them and put a heavy force of gunboats in the river.

Thus Lee's army was cut off from Europe; but by this time General Sherman had started north from Savannah and it was necessary to supply him by the same route which Lee had used. With this object, Major-General Schofield, with 21,000 men, was transferred from Tennessee to the Chesapeake and thence by sea to the Cape Fear river, in order that the large force of nearly 40,000 men thus assembled there and at New Berne, N. C., might make Sherman certain of supplies and support as he approached the army of Joseph Johnston. The Army of the Ohio arrived in the Cape Fear River February 9 and landed between Fort Fisher

and the lines two miles north of it held by General Terry's forces. The Confederate forces under Hoke still held their entrenched position between Masonborough Sound and the river opposite to Fort Anderson. On the west side of the river the Confederate line extended from Fort Anderson to a large swamp three-quarters of a mile distant. Both these positions were secure against direct attack. On the other hand, General Terry's position was supported on both flanks and in the rear by the gunboats, besides which he held Smithville and Fort Caswell.

Since the navy had moved inside the river, it had been waiting for the arrival of light draft monitors to attack the river forts, and in the meantime had cleared out torpedoes as far as Fort Anderson. The obstructions under the forts were of heavy cob work and stone and were impassable without reducing the forts. On February 11 General Terry's line was advanced, supported by the gunboats, and entrenched so far to the front as to require the enemy to hold his lines in force. Arrangements were then made to attack the right flank of the Confederate eastern wing with the gunboats, while two divisions were marched up the ocean beach to a point beyond the enemy's position, where they were to meet and receive a flotilla of pontoons and navy boats and haul them across the beach to the sound and then cross the sound in them. Bad weather delayed the execution of this plan, so on the night of the 14th of February the pontoons were sent up the beach on their wagons. An unusually high tide delayed the pontoons, so that the crossing could not have been complete before daylight, whereupon the attempt was abandoned. The two divisions crossed to Smithville instead, whence, on February 17, they marched against the Confederate position at Fort Anderson and entrenched opposite it on the morning of the 18th. On the 17th one monitor and four gunboats bombarded Fort Anderson and continued the bombardment the next day at a shorter range and with ten additional gunboats. At 3 p. m. the fort was silenced but the gunboats continued firing till dark.

After the entrenchments were defensible, a detachment was left to hold them, and the main body marched around Orton Pond to fall on the rear of the fort, but during the night of the 18th-19th it was abandoned and the United States flag was hoisted on it at daylight. The navy at once began to clear the river of torpedoes. One division of the army marched to Fort Anderson and was ferried across Cape Fear river by the navy, while the other con-

tinued north and encountered strong field fortifications on Town Creek, a stream with all bridges destroyed and no ford for fifteen miles. Between the river and the road were swamps. This position was turned and attacked by a march through the swamp, after which the United States forces were directed on the communications of Wilmington. As soon as the Confederate forces on the eastern side of the river learned that Fort Anderson had been abandoned and that the river was open to the gunboats, they abandoned their own lines and fell back to a point about five miles below Wilmington.

The navy sounded and buoyed the channel and got the gunboats up to the obstructions and earthworks at the mouth of the Brunswick river on the 20th and opened fire. That night the gunboats were attacked by 200 drifting torpedoes, but the picket boats destroyed them with musketry fire. Only one vessel was injured by them.

Late on the 21st the gunboats and army made a simultaneous attack on the group of forts below Wilmington, but without success. On the 22nd, it was found that the progress made by the western column of troops towards the rear of the city and the railroad had brought about its evacuation and both columns occupied it.

As the railway was without rolling stock and the army without wagons, one corps was transferred by sea to New Berne and both corps then advanced from Wilmington and New Berne to Goldsboro, where they effected a junction with General Sherman on April 24, opening a new base for him and bringing a reenforcement of 25,000 men.

In the operations from Fort Fisher to Wilmington, both the Federal Army and Navy understood the part that was proper to each, and the result was complete harmony between the two services, accompanied by success. The situation was such that, alternately, each supported the other's movement and neither could move up the river much in advance of the other, since the Confederate ships and field forces were supporting each other in a similar manner, although the latter combination was not formidable when properly attacked by the army and navy in cooperation.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OPERATIONS OF THE NAVY AND MARINE CORPS IN THE PHILIPPINE ARCHIPELAGO, 1898-1902.

By LIEUTENANT-COMMANDER A. P. NIBLACK, U. S. Navy.

While the services of the navy and marine corps in the wars with Great Britain, with Tripoli, and with Spain, have been so commanding as to receive universal recognition, equally important but less conspicuous service in the Mexican and Civil Wars have been entirely overshadowed by those of the army. Only the student may learn that, in the Civil War, the supplies of the Confederacy were cut off and the South starved out by the most remarkable blockade in history, and that by the naval operations in the Mississippi River and adjacent waters the backbone of the Republic was broken.

The navy and marine corps are suffering to-day from a similar eclipse in the matter of the Philippine Insurrection. The peace proclamation of July 4, 1902, does not mention in the slightest way the services of the navy and marine corps, and gives to the army the entire credit for the suppression of the insurrection.

In looking over the annual reports of the chief of the bureau of navigation from 1898 to 1902 inclusive, and of the commandant of the marine corps for the same period, it seems that the detailed reports of commanding officers are rather meager. Many direct engagements and many actions in co-operation with the army are not mentioned. Certainly if the facts are not given in official reports, the public at large may be excused for being ignorant.

Herewith is published a summary, chronologically arranged, of the engagements and incidents of the entire campaign of the navy and marine corps in the Philippine Archipelago from 1898 to July 1, 1902, inclusive, as set forth in printed reports, supplemented by a few unmentioned ones known to the writer. It is

hoped that other officers, both of the navy and marine corps, will supplement this summary with dates and facts of other operations within their knowledge, and that the Naval Institute will publish a revised summary of events as a permanent record. This is not intended for the benefit of any individual, but merely as a record of the bare facts of history. Some one may later take it upon himself to expand the outline into a fuller history before it is too late to stem the tide of popular ignorance and indifference. Many officers, from a false sense of modesty, have thought so little of their own work as to neglect to report operations reflecting credit upon themselves, but *esprit de corps* is a more important consideration than the gratification of such feelings, and the interests of the individual are as nothing compared with those of the service at large.

SUMMARY.

1898.

May 1. Manila Bay.

May 1 to August 13. Blockade of Manila.

July 8. Raleigh and Concord took Grande Island, Subic Bay, and captured the Spanish garrison of Olongapo.

August 13. Admiral Dewey's squadron co-operated with the army in the taking or surrender of Manila.

December 26. Baltimore convoyed General Miller's expedition to Iloilo.

1899.

February 6. Insurgent attack on Manila. Fleet participated actively in the repulse.

February 13. Boston and Petrel bombarded Iloilo and took the town, the army expedition under Brigadier-General Miller participating.

February 22. Landing party from U. S. S. Petrel occupied Cebu.

March 9 to 17. Bennington convoyed army expedition to the Southern Islands.

March 11 to 15. Boston visited Zamboanga and Sulu Islands to reconnoitre. Inspected Spanish gunboats.

March 31. Baltimore bombarded insurgent trenches at Dagupan, Lyngayen Gulf.

April 12. Yorktown at Baler. Gilmore captured.

April 13 to 20. Concord and Petrel convoyed purchased Spanish gunboats from Zamboanga to Manila.

June 16. Oregon destroyed insurgent trenches at Anda, Lyngayen Gulf.

June to December. Castine cruised in Sulu Archipelago, first to prevent uprising of natives prior to army occupation, afterwards co-operating with army.

September 10. Bennington shelled fortifications at Legaspi.

September 14. Concord and Monterey destroyed two insurgent schooners at Aparri.

September 16. Monadnock and small gunboats shelled fortifications back of Cebu.

September 17. U. S. S. Urdaneta was captured and burned in the Orani River.

September 18. Monterey, Charleston, Concord, and Zafiro shelled insurgent battery at Olongapo, Subic Bay.

September 23. Battalion of sailors and marines from the Baltimore, Charleston, and Concord, under command of Lieutenant J. C. McDonald, U. S. N., landed at Olongapo and destroyed a 6-inch gun mounted by insurgents.

October 3. Sailors and marines from the U. S. S. Baltimore, and marines from Cavite, joined army in attack and capture of insurgent forces at Imus.

October 8. Battalion of marines from Cavite, under Lieut.-Col. G. F. Elliot, U. S. M. C., took Noveleta, 2 killed, 14 wounded, U. S. S. Petrel co-operating.

October 15. Concord bombarded town of Tigbanan and prevented insurgents crossing to Negros Island.

October 23. Gunboat Paragua co-operated with army in seizing the ports of Bonati, Ajui, Concepcion, Estancia, and Capiz on Panay Island.

October 29. Concord bombarded Bonati.

November 5. Concord bombarded San Juan de Buena Vista.

November 7. Princeton, Bennington, Manila, Helena, Samar, Callao, convoyed General Wheaton's expedition, bombarded San Fabian, and covered landing of forces.

November 16. Castine and Manila took Zamboanga, and later convoyed troops and participated in the occupation of the Sulu Islands.

November 25. Oregon landed battalion, captured Vigan (2

miles in the interior) and rescued 350 Spanish prisoners, getting the first news of Gilmore's whereabouts.

November 27. Concord assisted troops in the capture of Bonati.

December 5. Newark reinforced army garrison at Vigan.

December 6. Concord assisted at the taking of Ajui.

December 10. Baltimore and Oregon participated with expedition under General Grant in the capture of Olongapo, Subic Bay, and ships garrisoned Olongapo with marines.

December 10 to 29. Newark, Princeton and Helena received the surrender of Aparri, the Northern Islands and the northern provinces of Luzon.

December 16. Concord assisted in the capture of Romblon.

December 20. Capt. Draper, U. S. M. C., with force from Cavite, occupied Olongapo, Subic Bay, as a garrison.

December. During this month the Wheeling and Panay cooperated with the army along the northwest coast of Luzon.

During 1899, marine garrisons were established, in addition to Cavite, at Olongapo, Port Isabela, Balbac L. H., Malabrigo L. H., Cabras L. H., Capones L. H., Cape Melville L. H., Caridad, Dalahican, Sangley Pt., San Roque, Canacao, and Santiago L. H.

The following ships were engaged, in addition to the above-mentioned duties, in patroling, blockading, and intercepting insurgent commerce and food supply, and in co-operating with the army by communicating with them, carrying supplies, transporting them from place to place, and assisting in maintaining their communications: Albany, Baltimore, Bennington, Callao, Castine, Calamianes, Charleston, Concord, Culgoa, Guardoqui, Helena, Manila, Monterey, Manileno, Mariveles, Mindoro, Monadnock, Pampanga, Paragua, Petrel, Princeton, Oregon, Olympia, Samar, Newark, Wheeling, Iris, Glacier, Urdaneta, Yorktown, Basco, and Zafiro.

1900.

During this year the following ships were engaged principally in patrol duty, blockading insurgent ports or intercepting trade between them: Baltimore, Basco, Don Juan de Austria, Calamianes, General Alava, Guardoqui, Isla de Luzon, Leyte, and Princeton.

The following ships were also engaged in similar work at times, but were principally in active co-operation with the army in con-

voying expeditions, covering the landing operations, carrying detachments of troops, maintaining communications, and assisting in the operations by bombarding, etc.: Bennington, Callao, Castine, Concord, Helena, Manila, Manileno, Marietta, Mindoro, Nashville, Newark, New Orleans, Oregon, Pampanga, Paragua, Petrel, Quiros, Samar, Villalobos, Wheeling, Yorktown, and Zafiro. The details as to dates and extent of service are set forth in the cruising reports.

Numerous additional posts were garrisoned by detachments of marines, but the operations in China withdrew suddenly a large portion of the officers and men available.

January. Princeton took possession of the Batan Islands.

February 16. Small marine detachment near Olongapo was attacked by insurgents and two men killed.

February 17. Punitive expedition under Captain H. C. Draper, U. S. M. C., from Olongapo, attacked town of Morong, and destroyed insurgent blockhouse, arsenal and ammunition.

February 23. Nashville bombarded town of Benictican near Olongapo, and marine detachment destroyed town.

February 27-28. Expedition on General Alava, under command of Lieutenant J. H. Gibbons, U. S. N., in Gulf of Ragay, rescued and captured 522 persons, prisoners in the hands of the insurgents, including 10 Americans, 460 Spanish officers and soldiers, and a number of priests and friendly Filipinos.

March 5. Nashville landed a marine detachment from Olongapo, under Captain Draper, U. S. M. C., and in co-operation with the army took the town of Bagac, capturing arms and ammunition.

March 8. Lieutenant Logan Feland, U. S. M. C., commanding a marine detachment from Olongapo, captured the town of Calapacuan and destroyed insurgent provisions.

April 7. Marietta took possession of town of Baler, Island of Luzon.

April 9. Marine detachment on Leyte drove insurgents from town of Calaguaguin near Olongapo.

May 13. Pampanga engaged insurgents at Masin, Island of Leyte.

May 25. Pampanga shelled insurgent trenches at Santa Margarita, Island of Leyte.

May-June. Paragua engaged insurgents at Patnongon and Jaland River, Island of Panay.

June 29. Concord shelled insurgent trenches at Catbalogan.

July 6-15. Concord and Marietta shelled insurgent trenches at Catbalogan.

July 20. Concord shelled insurgents at Kalbayac.

September 19. Landing party from Isla de Cuba occupied Malabang.

1901.

During this year the following ships were engaged in patrol duty, blockading insurgent ports or intercepting trade between them, and in active co-operation with the army in convoying expeditions, covering the landing of troops, carrying detachments of troops, maintaining communications and assisting in the operations by bombarding, or by landing men from the ships: Annapolis, Arayat, Basco, Calamianes, Callao, Castine, Concord, Don Juan de Austria, Frolic, Isla de Cuba, Isla de Luzon, Leyte, Marietta, Mariveles, Mindoro, New York, Pampanga, Panay, Paragua, Petrel, Princeton, Piscataqua, Quiros, Samar, Vicksburg, Urdaneta, Wampatuck, Yorktown, and Zafiro.

In the annual reports of the chief of the bureau of navigation for 1901 and 1902, giving the summaries of the cruising reports in the "Movement of Vessels," the report of the Don Juan de Austria is a model of clearness and effectiveness. For the first three months of 1901 it covers nearly five printed pages. The activities of other ships are in many cases covered in a few vague lines, or the interesting details are concealed in such remarks as "Co-operating with Army," "Cruising on station," "Communicating with garrison," etc. Full reports of operations are supposedly on file elsewhere. On the other hand, the commandant of the marine corps publishes full details of all operations of marine detachments, and incidentally the operations of ships in connection therewith. There is also always a full list of all medals of honor and commendatory letters.

The following summary is taken from the "remarks" in the cruising reports for 1901, and from the report of the commandant of the marine corps. The Don Juan de Austria is abbreviated to Austria, and only a few of the numerous recorded operations are given in the summary:

January 17. Austria shelled insurgent outpost at Donsol.

January 20. Boat expedition from Austria to Buena Vista secured 12 prisoners.

January 28. Army expedition assisted by detachment from Austria landed at Maringondon and made a successful attack upon the insurgents.

January 31. Expedition from Austria landed at Jamuraon, drove off insurgents and destroyed supplies.

February 2. Austria surprised the town of Claveria at dawn, capturing many insurgents and valuable papers.

February 3. Same service at the town of San Pascual.

February 4. Austria returned to Claveria, and "brought on board several persons, including Padre, shown by captured documents to be active insurgents."

(The brief record of the Don Juan de Austria given above is but for a few weeks, but throughout the year the cruising report shows continued activities, and it is too long to quote.)

February 26. Calamianes engaged insurgents at Agusan River, Island of Mindanao. Ensign A. N. McCarthy, U. S. N., commanding, was commended for this service.

March 18-28. Vicksburg co-operated with the army in the capture of Aguinaldo.

October 24. New York landed two companies of marines at Basey, Samar Island, relieving Ninth Infantry.

October 25. Vicksburg, Frolic and Zafiro landed 159 marines at Balangiga, Samar Island, relieving Seventh Infantry.

October 28. Vicksburg destroyed insurgent supplies at Gigosi.

October and November. Vicksburg engaged in combined operations with army in islands of Leyte and Samar.

November. Annapolis engaged in investigating slave trade.

November 5. Detachment of marines, under Major Waller, defeated insurgents at Sohoton.

November 8. Marines defeated insurgents at Iba, killing 9, and capturing 11.

November 9. Marine detachment, under Captain Porter, engaged insurgents near Balangiga, killing 1, and capturing 7.

November 13-14. Second attack on insurgents at Sohoton, 12 killed.

November 17. Marine detachment surprised insurgents near Sohoton.

December 28. Marines, under Major Waller, started from Lanang to march across Island of Samar, a distance of about 190 miles.

1902.

Peace proclamation July 4, but previous to this, the following services were rendered by the navy and marine corps:

The following ships were engaged in patrol duty, blockading insurgent ports, etc., and co-operating with the army and marine corps: Annapolis, Arayat, Basco, Calamianes, Don Juan de Austria, Frolic, Guardoqui, General Alava, Isla de Cuba, Isla de Luzon, Mindoro, Pampanga, Panay, Paragua, Piscataqua, Princeton, Quiros, Villalabos, Wompatuck, Yorktown, and Zafiro.

Throughout the cruising reports for 1899, 1900, 1901, and 1902, it is surprising to note the number of times the various ships were engaged in pulling army transports off the various reefs and shoals.

January 4. Marine detachment, under Lieutenant Carpenter, attacked insurgents at Odoc, Island of Samar, killing 8, and capturing 4.

January 6. Major Waller's expedition reached Basey after crossing the Island of Samar, enduring great hardships.

January 11. Captain Porter's detachment, from Major Waller's column, reached Lanang.

January 18. Lieutenant Williams's detachment, from Major Waller's column, reached Lanang.

January 19. Captain Bearss, with detachment of marines, established outpost at Quinapundan.

January 25. Lieut. Gridley, with detachment of marines, defeated the insurgents at Iba.

Samar battalion of marines, under Major Waller, returned to Cavite March 2, 1902.

As a digression, it may be interesting to consider the system of rewards to officers and men of the navy and marine corps in connection with the services rendered. In General Order No. 55, of July 19, 1901, the Navy Department published a list of medals of honor and commendatory letters issued to officers and enlisted men of the navy and marine corps for services in China, the Philippines, etc. Of the medals of honor, 56 were for services in China and 7 for the Philippines. Of the commendatory letters, 35 were for services in China, and 15 for the Philippines. This list is certainly not complete. The value of official recognition depends upon the promptness and certainty of its bestowal. A full list of the officers and men of the navy and marine corps who have

received medals of honor or letters of commendation for services in the Philippines should now be published.

The individuals who get numbers or medals of honor or commendatory letters, of course owe something to special opportunity. The sinking of the Merrimac at Santiago was all right, but there were enough volunteers to sink a mile of such ships. The opportunity to be allowed to sink her was a reward in itself and quite a sufficient one for the individual, but in conferring special honors on its brave and daring, a service also honors itself. When Great Britain makes field marshals and peers of its distinguished soldiers, it loses nothing in reflected military prestige, and it is this view of the case that we seem to miss. In honoring Hobson and his crew, the navy honored itself. That is the important point.

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A METHOD OF DETERMINING THE LATITUDE AT SEA WITHOUT TIME.

By X.

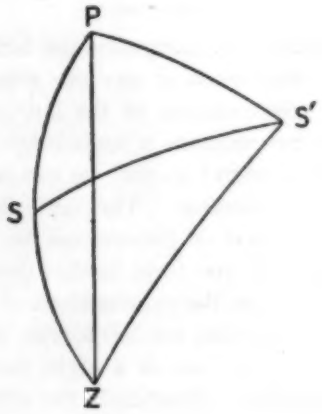
By the routine methods of navigation the latitude and longitude are in general not determined at any one time independently of one another. The determination of the latitude by the meridian altitude of the sun necessitates a knowledge of the Greenwich time (at least approximately) so that we can calculate its declination at the time of culmination. The same is the case with the planets. The only method in general use by which the latitude may be obtained, without the time, is that derived from the culmination of a star. But as the culminations of the principal stars, such as are used in navigation, are infrequent, this involves tedious waiting. Furthermore, the use of a night horizon is unsatisfactory and often impossible. Practically the altitude of a star can be determined only under three conditions, at twilight, at dawn and with sufficient moonlight. Generally, therefore, we can only utilize the culmination of a star when the horizon is sufficiently illuminated by the moon.

The problem then is, how to determine the latitude instantly (without waiting) when there is a working horizon (twilight or moonlight). This can be done quite simply in the following manner: Let two observers take simultaneously the altitudes of any two stars, S and S'. PSS' is a fixed astronomical triangle, the elements of which are supposed to be previously tabulated. P is the celestial pole and Z the zenith. The elements of such triangles as would be useful could easily be incorporated in a single page of the Nautical Almanac. The element SS' we derive at once from the table and taking our observed distances SZ and $S'Z$ we calculate at once the spherical angle $S'SZ$. The angle

PSS' is taken from the table and we have at once the angle PSZ. Knowing then the sides PS and SZ and the included angle PSZ, we obtain easily the side PZ which is the colatitude. As a check on our work we can use the triangle $PS'Z$.

If the time is taken at the same instant as the altitudes, we can obtain, of course, our hour angle and thus the longitude.

With the two altitudes and the time it would be equally possible to derive two Sumner lines and their intersection would give us our latitude and longitude at the time of observation. The work by the two Sumners, however, is about twice that by the method just described.



This method is designed chiefly for the determination of the latitude and gives us a means, hitherto wanting, of obtaining it at once (without waiting) and without the time. It implies, of course, the existence of a suitable horizon, as must be the case for all star observations.

The following example is subjoined to illustrate the method. The following simultaneous altitudes of Pollux and Capella were taken at twilight: Pollux, 54° 35′; Capella, 36° 51′. Required the latitude.

From our previously prepared tables we find that

$$SS' = 34^\circ\ 15'\ 33'' \qquad PSS' = 107^\circ\ 51'\ 12''$$
$$PS = 44^\circ\ 5'\ 57'' \qquad PS'S = 48^\circ\ 40'\ 8''$$
$$PS' = 61^\circ\ 44'\ 30''$$

Correcting for refraction and dip (5′ 22″ dip), we find that the coaltitude of Pollux was 36° 31′ 3″ and of Capella 53° 15′ 40″.

Solving the triangle $SS'Z$, we find that $SS'Z = 101° 22' 24''$. Therefore the angle $PS'Z = 150° 2' 32''$.

Solving the triangle $PS'Z$, we obtain $PZ = 94° 14' 25''$.

As a check we can use the triangle PSZ. We easily find that the angle $S'SZ = 46° 43' 8''$, and that, therefore, the angle $PSZ = 154° 34' 20''$. Solving the triangle PSZ we obtain as the value of PZ, 94° 14′ 56″.

The latitude was, therefore, to the nearest minute, 4° 15′ South.

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THE SIGNIFICANCE OF OVERCROWDING.*

By Surgeon Henry G. Beyer, U. S. Navy.

In the early part of last May I was ordered as a member on a board charged with the duty of investigating the sanitary condition of the navy yard at League Island, Pennsylvania. The immediate cause for assembling the board was the deplorable fact that cerebro-spinal fever had again broken out there and threatened to become epidemic. The duty of the board was (1) to trace the cause of the disease to its origin and (2) to suggest means for stamping it out.

It was soon found that the disease had made its first appearance in the temporary barracks, erected less than a year ago on the eastern end of the island, upon a soil that had been pumped up from the river bottom not many years since. These barracks, in which the recruits were quartered, formed, therefore, the first object of the attention of the board. Upon a most careful and thorough examination into the sanitary features of these buildings during which, among other things, account was taken of the character of the accommodations and the number of recruits that were compelled to live in them, the board came to the unanimous conclusion that the cause of the present outbreak of the epidemic in these barracks was lack of air-space, or, in other words, *overcrowding*. Since lack of sufficient air-space or overcrowding alone could never be accused of giving rise to an infectious disease, due to a specific microbe, the conclusions of the board, it would seem, would need some further explanation. The subject is of such im-

*Read at the Naval War College, July 22, 1904.

portance, the danger of its recurrence so great, that the exact relation of overcrowding to an epidemic of this nature must be precisely defined, its influence as an indirect cause of the perpetuation of the epidemic absolutely fixed in your mind, in order not only that the danger of it may be properly appreciated by you but, also, in order to enable you to take intelligent measures for its prevention in the future. To attempt to give you this needed explanation is the object of this lecture.

There are three barracks in all at League Island, erected less than a year ago. Each building has two floors; there is no cellar. The first floor has a cubic capacity of 22,140 feet, gives berth to 144 men, thus allowing a cubic air-space per man of 154 feet. The second floor has an air-space of 24,800 cubic feet, and being likewise occupied by 144 men, gives an air-space of 169 cubic feet. This gives an air-space per man for the entire building of 161 cubic feet. Since the three buildings are all alike the result of these measurements may be taken as typical for all. Any further details as to the construction of the barracks, the soil they are built upon, etc., etc., may be here omitted as foreign to the subject in hand.

It will suffice for our purpose to have established the deplorable fact that the air-space allowed per man in these barracks amounted to less than it was on the receiving ship Lancaster when that ship would be crowded to its full capacity; that it was a great deal less than that allowed in the Marine Barracks and that it did not come up to the amount of air-space prescribed by law, in the mercantile marine, and to be allowed and provided for emigrant passengers. The lowest class of foreign workmen have, indeed, better quarters than our recruits have in these barracks. Our own young spirited American boys, arriving full of hopes and ambition, are expected to live, flourish and grow into manhood, without a supply of the cheapest and most essential element, fresh air, and put up with such conditions without complaint. Except perhaps for the merely temporary purpose of filling your ships, I leave it for you to decide as to which would be for the more enduring benefit of the service; never to enlist boys until they can be received into quarters provided for them, that are at least sanitary, or, to enlist them and pack them into quarters in which their first impressions of the service are to see their comrades die from a preventable disease?

From time immemorial, overcrowding and life in ships have been inseparable. From actual suffocation, from entire want of air, to the dying by slow degrees from bad air, we have abundant material on record. Even to-day, life in our own best ventilated ships, when visiting the sleeping quarters of our men, in the middle of the night, the air cannot be kept within the limit set by hygienic requirements, except in rare cases. Overcrowding, like a doubled-edged sword, influences human health in two ways: (1) by diminishing the supply of what is considered the source of all life, the oxygen of the air, it lowers the resistance of the living to all injurious environmental influences to life, inevitably; and (2) by creating conditions under which the particulate and living enemies of human life, the parasites, acquire greater power and virulence.

This struggle which is going on in disease between the individual and the disease-producing germ may be well expressed by the general formula: $D = \frac{R}{V}$, first applied to it by Dr. Theobald Smith, and where D stands for disease, R for the resistance of the individual and V for the virulence of the disease-producing agent. To bring about recovery, we must increase resistance or diminish virulence, or do both.

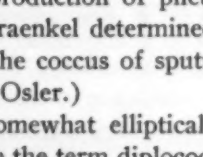
How depressing is the influence of impure air or the want of any air you all know from personal experience. How it influences those already weakened by disease or other influences injurious to normal health, I only need to recall to your mind an instance recorded in history. Thus, the English hygienist Lind reports the following instance: A French fleet of vessels, in the year 1757, was engaged in transporting 1000 convalescents from the various hospital tents at Louisburg at Brest. After six days out every one of these convalescents had died and been thrown overboard. In other words, the natural resistance of these patients having already been decreased by disease, it needed only to deprive them of good fresh air to extinguish entirely the remaining spark of life. Blane, while fleet surgeon of 40 line of battleships with 21,608 men, cruising in the West Indies, between the years 1780 and 1783, reports the loss of 3200 men from disease alone, and he attributes this enormous death-rate to overcrowding and insufficient ventilation. Many of the men, he says, especially those who were obliged to work below, actually died from suffocation.

How overcrowding creates conditions under which the parasites of the infectious diseases acquire greater virulence needs an explanation which can only be appreciated by a knowledge of the cultural characters and biological peculiarities of the germs causing infectious diseases. This knowledge I will try to furnish.

There are two diseases, caused by two separate organisms, both belonging to the class of cocci, a description of the characters of which will furnish you with the key to an understanding why overcrowding is the cause of the increase in their virulence. These diseases are pneumonia and cerebro-spinal meningitis and of these I will now proceed to give you a brief account.

1. Pneumonia is now generally regarded as an infectious disease caused by a specific organism which was first seen by Klebs and others, then discovered by Pasteur and Sternberg in the saliva as well as in the blood of rabbits injected with saliva, about 1880. There was, however, at that time, no suspicion that this organism was concerned in the production of pneumonia, and it was not really until 1884 that Fraenkel determined that the organism, up to that time known as the coccus of sputum septicæmia, was the cause of pneumonia. (Osler.)

The organism is a somewhat elliptical-shaped coccus, usually occurring in pairs, hence the term diplococcus. When it occurs in the sputum, a capsule can always be demonstrated. It has been found in various tissues and organs, including the blood. Outside the body the organism has been found in dust and the sweepings of rooms.



The coccus is not considered a very resistant one and grows only under certain favorable conditions. It does not grow below a temperature of 24° C. and flourishes best at blood temperature. In many cases it has been known to refuse to grow at all on any artificial culture medium, except on blood-serum-agar. On all artificial culture media the diplococcus of pneumonia rapidly loses its virulence, and finally dies. In order to maintain its pathogenic activity—and this is one of the important characters to remember in connection with the subject of overcrowding—it must be passed frequently through living and susceptible animals. But when thus sent through animals, generation after generation, its viru-

lence can be increased to an astounding and fabulous degree. Thus, Neufeld, for instance, by passing a pure culture through a series of rabbits, was finally able to obtain a culture over 100,000 times more virulent than the one he started with.

In the sputum from pneumonic patients the virulence of the organism is found to be far more intense than in the ordinary artificial cultures and such sputum, when adhering to clothes and bedding retains its virulence even after drying and exposure to light for a period varying from 11 to 55 days; even direct sunlight does not destroy it in less than 12 hours.

The coccus is invariably found in the expectorations of pneumonic patients, especially abundant is it in the early days of the disease. It also occurs in the mouths and respiratory passages of persons, not at the time suffering from pneumonia. The frequent presence of the coccus in these places explains the occurrence of pneumonia at different times and under certain other definite outside conditions. Whenever seasonal changes take place, bringing about changes in the respiratory passages, such as colds and catarrhs, these cocci, normally contained in these places and perfectly harmless, acquire at once a greater virulence, and when people are most apt to seek the protection and the comfort of their fireside, as they do during inclement or cold weather, most of the cases of pneumonia have been found to occur. During such times, it will be easily seen that the chances for the more frequent transmission of the germs from person to person are the greatest.

Direct transmission is proven by the fact that a patient in the bed next to a pneumonia case has frequently taken the disease and two or three cases may follow in rapid succession in the same ward. Moreover, the records of the greatest endemics and epidemics have always come from places where many people live together.

We already know that the passage of the organism of pneumonia from one person to another renders the resulting generation of organisms much more virulent than it was before, and that, consequently, much fewer germs of such a generation will be required to cause a fresh pneumonia infection. Among the more remarkable outbreaks in this country is that reported by W. B. Rodman in Frankfort, Kentucky. In a prison, with a population of 735, there occurred in one year 118 cases of pneumonia, with 25 deaths. At the penitentiary at Amberg, during a period

of five months, there were 161 cases with a mortality of 28 per cent. In the Middlesborough epidemic there were 682 persons attacked with a mortality of 21 per cent.

But enough has been said, I think, to show you in what manner overcrowding from any cause may become the one determinant condition and the initial cause of an outbreak of an epidemic of pneumonia in such places as ships, barracks, prisons and schools, and this for two principal reasons: (1) because the close proximity of persons renders the transmission of the disease-producing germ much more easy and frequent, and (2) because the passage of the microbe through a series of persons renders its virulence infinitely greater.

(2) Cerebro-spinal meningitis, sometimes also called "spotted fever." This disease has at all times been especially prevalent in the United States. Thus, during 1805 and 1830, when the disease first became generally known, it prevailed extensively and almost exclusively in the United States, making, however, its appearance in a few places in Europe. Between 1837 and 1850, it not only occurred in the United States but became more or less epidemic in France, Italy and Denmark. The disease attained its greatest prevalence between 1854 and 1875, when it made its appearance in succession in Sweden, Holland, France, Germany, Switzerland, Italy, Portugal and Austria, and finally also in Africa and South America. During the fourth period of its epidemic prevalence, that is from 1875 to the present time, the United States has again furnished the greatest contingent of cases, and quite recently an extensive epidemic of 3000 cases was reported from Portugal. In this country, during 1898 and 1899, it prevailed in a mild form in 27 of our States. The outbreak in Boston was fully described by Councilman, Mallory and Wright; that in Chicago by Class; that in Baltimore by Osler in his Cavendish lectures; and that in New Orleans by Ballard; and that in St. Louis by Gradwohl. The latest epidemic in New York seems to be quite serious. In two months almost 500 deaths from this disease were reported, while for the same period last year only 64 deaths occurred from the same disease.

The disease is caused by a coccus that is invariably found in the pus cells of the inflamed membranes of the brain and spinal cord as well as in the cerebro-spinal fluid obtained by lumbar puncture. Originally discovered by Weichselbaum as being the cause

of the disease, since then found to be associated with it by many of our own countrymen and recent studies, made in Germany, France and Portugal, have all been confirmatory of the constant association of this organism with the disease.

I will entirely pass over the symptoms of the disease, as these have no bearing upon the points I wish to make, except to say that the disease involving the brain and spinal cord is a horrible one to watch, ending in the complete paralysis of all the muscles, of general sensation and also of the special senses.

In describing the cultural and biological characters of the coccus, I will, likewise, limit my description to those that it is most necessary to know, in order to appreciate and understand why overcrowding must be one of the most important aids in the spread of the disease. The coccus occurs in pairs within the polynuclear cells in the pus covering the brain and its membranes. The flat surfaces of two adjacent organisms are always turned toward each other. This coccus, like the pneumococcus,

is very delicate and thrives only under certain favorable outside conditions. It refuses to grow at all below a temperature of 27° C. and even at blood temperature it rapidly loses its virulence on all artificial culture media. It does not survive the process of drying and, when exposed to direct sunlight, it dies within 24 hours. When kept in dark and damp places the cultures or the sputum or nasal discharges, in which it may be contained, remain active very much longer. The organisms are found in the brain and spinal cord, sometimes also in the blood, urine, sputum, and in the mouths and nasal cavities of those affected with the disease. It is well, however, to remember that, especially during epidemics, the organisms have frequently been discovered present in the nasal cavities and skin secretions of those in good health, in which cases their presence was always associated with a certain amount of inflammation. Since it has been found that the organisms were also present in the nasal cavities of those who had recovered from the disease for a long time after recovery, it is easy to see that the disease may spread from convalescents.

It was already noticed in 1840 that the disease was often trans-

ported from place to place by troops. In this manner it has been transported from France to Algiers by soldiers. One of the most direct and frequent means of its transmission from person to person is through the nasal secretions when they are expelled in the form of a spray, as is the case in sneezing or coughing. The germs are indirectly transferred through handkerchiefs, towels, clothing, bedding and the various articles of food and the utensils in which these are served. The most frequent entrance into the body is gained through the nose, whence it makes its way into the skull cavity through a perforated plate of bone. The period of incubation is very short, lasting only from three to four days.

The disease in its manner of spreading seems somewhat erratic; it seems to concentrate itself upon certain localities, such as barracks, prisons, factories, schools and homes. In the Prussian Army, from 1873 to 1889, 215 cases occurred with 88 deaths, a mortality of nearly 50 per cent. In the Austrian Army, between 1880 and 1884, 102 cases occurred with a mortality of nearly 14 per cent. In the Italian Army 263 deaths occurred between 1881 and 1888. In England but a small epidemic occurred at Devonport, amounting in all to 13 cases. In France, out of 62 epidemics, 43 occurred in the army. According to Abbott, Love states, that, at New Orleans, in 1847, the disease attacked one regiment which happened to be quartered in particularly poor barracks that were built on damp soil; while an adjacent regiment much more favorably housed escaped entirely.

As regards the influence of seasons, it always is the late winter and the early spring months that furnish the largest number of cases, and this occurs uninfluenced by geographical location. In this respect it resembles pneumonia.

If we were to ask which are the factors that are most constantly concerned with the spread of this disease, we will have to answer that all those conditions that imply close association of large or small numbers of people must favor it most. In many epidemics, the army has been exclusively attacked. Not only has this been the case, but certain barracks have been singled out and these have always been found overcrowded. Then again, among soldiers, it has always been the recruits which the disease has attacked by preference and to whom always the poorest quarters have been assigned. Moreover, the officers of an army post and the better-quartered petty officers have remained free from the

disease. The condition of overcrowding is also in harmony with the season of the year which furnishes the largest number of cases.

The temperature of overcrowded rooms is usually high, relative humidity very great, ventilation nil, because the windows are apt to be kept closed. All these are conditions under which the specific organism flourishes. Finally the direct transmission of living germs from person to person is made much more easily possible. Hence also the immediate arrest of the disease when ventilation is improved. There can hardly be any reasonable doubt of the fact that overcrowding may not only be the cause of the spread but even that of the start of an epidemic of cerebro-spinal meningitis, because it has been shown in every well observed and described epidemic that the conditions under which the disease spreads most fiercely, which is overcrowded rooms, are at the same time the conditions under which the specific germ flourishes best, becomes most virulent, and is easiest transmitted direct from person to person.

To sum up: The reasons why overcrowding is most directly concerned in the causation of epidemics like pneumonia and cerebro-spinal meningitis, are, that it first weakens the resistance of men through depriving them of good air, and that it, secondly, increases the virulence of the germs, causing the disease by giving them a better opportunity of passing through a number of patients at shorter intervals than they would have in better sanitary quarters.

Thus, you will see, gentlemen, your lecturer on hygiene often finds himself in the unenviable position to, *first,* find fault with existing conditions and, *next,* make suggestions for correcting the fault. The former is not infrequently resented and the latter, to say the least, is not in very great demand. Nevertheless, I would like to have you remember that these are the essential features of my problem, which is to teach men how they may live longer, healthier and, therefore, happier.

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DESERTION AND ITS PREVENTION.

By CAPTAIN A. S. WILLIAMS, U. S. M. C.

The appalling number of desertions which occur annually in all branches of our military establishment calls for the immediate application of remedial measures. In deciding in what those measures shall consist, we must consider the value of the present means of prevention authorized by law.

We will not attempt in this paper to go into the causes, for these are as various as the desertions, and, moreover, we firmly believe that every person who enlists was a free agent, sober and in the full possession of his proper senses when he swore to remain in the service for a certain term of years.

Were the conditions in the service made as pleasant as possible, there would still be desertions, for human nature is inconstant in its desires and men will be enlisted who never should have enlisted.

The binding force of an oath is recognized by all peoples, from the most highly civilized to those lowest in the social scale, yet after having taken an oath no less solemn than the one under which death sentences are adjudged, we find thousands annually violating it. These men are not insensible to the obligations it imposes on them; they fully realize what is meant by their oath; yet they violate it. Why? Because they see the violaters of the same oath in the rare cases of apprehension, treated with such leniency as to cause its binding effect to be lost on them. They see men who have deserted, apprehended, tried, convicted, sentenced, and after serving part of the sentence, restored to duty, or restored to duty at the expiration of the term of imprisonment. Worse still, they see violaters who surrender themselves punished as for some slight infraction of orders.

Herein lies the gist of the trouble. The military crime of desertion, despite its increasing prevalence, is apparently not considered a serious offense by those in authority. Is a man who thinks he has a reason for deserting to be blamed for taking advantage of the official apathy which will hardly secure his apprehension, and which will practically overlook or condone his offense?

This apathy is wrong. Desertion is not a single crime; it contains in its performance other military crimes—disobedience of lawful authority, conduct prejudicial to discipline, and other major offenses that will occur to the reader who is at all familiar with the demoralizing effect of wholesale desertions.

As desertion is not a single offense, so desertion does not affect the deserter alone; its baneful influence is felt by every officer and man, and in every department of the service. This is when kept by deterrent punishments at a minimum. How much more harmful it is when allowed to go unpunished or slightly punished can not be stated too strongly. In a command it seems to run from company to company, from division to division, like a contagious disease, and will lessen a command as effectually as will an epidemic, leaving the men overworked and the officers discouraged and disheartened.

In considering the remedies for the deplorable state of affairs which now exists, we must define desertion with phraseology superior to exception, incapable of manipulation, and free from ambiguity. Winthrop defines a deserter as "one who absents himself from . . . . the service without authority, *and with the intention of not returning.*" This is perfectly clear, comprising a definition of absence without leave and a clause regarding intention. There is no room for quibble, and no one, however captious, could define it better as it is at present understood. Desertion is simply a permanent absence without leave. Starting with this definition, let us see of what assistance it is when we are confronted by the present actual conditions of military discipline.

Believing that several guilty men should escape punishment rather than one innocent person should suffer, those responsible for the military law and regulations under which we live, have surrounded the crime of desertion, or rather have obstructed the proving of it, with so many captious, quibbling and unmilitary rules and definitions, that a court-martial to find a deserter guilty

of desertion must ignore the strict letter of the law and find by common sense and the evidence before it, that a man who left his command without authority and remained away until privation caused him to surrender, or until apprehended, intended to permanently abandon the service.

How is "intent" to be proved? The most determined deserter has, no doubt, at certain periods of his absence, thoughts of returning; the most vacillating absentee sighs at times for a continuation of his stolen freedom. Shall courts-martial resolve themselves into psychic bodies? Shall they find a man guilty during the time his mind held one intention or during the time another was dominant? Or shall they rather consider the psychological moment when he started to scale the wall or had reached the foot of the gangway? These fine hair-splitting distinctions are well in civil practice, but military law must, in order to be effective, be summary.

All absence is not desertion—a protracted spree or any one of several conditions of mind or body may furnish a reason and perhaps a motive for that—but one merges into the other until the leaven of intention causes a difference. Just when this distinction is to be drawn none can say, and as we have seen, intention is altogether too elusive a factor to be of any use; we must draw an arbitrary distinction.

Let us define a deserter as "one who absents himself from .... without proper authority and remains so absent during ten days." This limit of ten days will cover probably all cases of plain absence without leave.

In this definition, which is not claimed to be best, but only better than the present one, we have a fair start and a proper foundation on which to build up a system of deterrent punishments, and in its application it would not overlook the intention—it simply would not look for it. Coercion, sickness, an hundred other reasons would constitute separately or together absolute defenses before a court-martial. It would not be hard for an innocent man to prove that he did not intend to desert, while on the other hand it is almost impossible to legally prove that a man did so intend. The burden of proof is on the defendant—that is the change.

The adoption of this definition is the first point made in this scheme of prevention, and whatever mistakes the article may

contain, by this desertion is at least made "punishable" in fact as well as in legal theory.

Having made possible by this definition the conviction of a deserter, it next remains to apprehend all who desert, *i. e.*, remain absent more than the limit of ten days.

To cover the cases of those men detained by civil authority, sickness, etc., a regulation should be issued requiring all absentees to place themselves in communication with the nearest available federal authority, commanding officers of military posts or naval stations, irrespective of service, recruiting officers, U. S. marshals or American consuls, stating the circumstances of their absence, and any particulars that would constitute a defense or extenuation of their act. This proceeding would be possible under almost any conceivable circumstances, and a proper use of it would save every innocent man. Having reported himself to federal authority, he could then be sent to the nearest station of his own service, the expense of his transportation to be checked, as now, against his pay. All men taking advantage of this regulation could then be punished for absence without leave if the circumstances of their absence called for punishment, and the service would be the richer for the presence of many men who, under present conditions, fear to return and surrender with the prospect of punishment before them; while the man who neglects to avail himself of the provisions of this order admits his intention of remaining away.

Having defined desertion without the factor of intention and having given absentees an opportunity to declare themselves, and the real deserter an opportunity to change his mind, it only remains to apprehend the deserter and bring him to trial, when his conviction is made certain by his own act.

Under the present system a description of the deserter is sent to the civil authorities and a small reward is offered for his return. The descriptive list is necessary, but it should be put in plainer language such as is used in describing civil criminals, and the reward, now $20, should be increased to $100. Twenty dollars is not large enough to tempt the police or county officers to watch or inquire carefully. This is especially true in the country. It is not large enough to tempt a county constable to brave the imagined and real intricacies of federal law, advance the expenses out of his own pocket, and wait, as he imagines he will have to,

for the slow-moving federal government to reimburse him. Considering the loss of time alone, he is hardly to be blamed for his neglect of duty—if it be his duty.

The apprehension of deserters requires detective work, for our deserter is not going to announce his status, and so the business of returning deserters falls to the smaller private detective companies. Some of these, in the larger cities, make a business of it, but it is known that if the deserter offers the detective more than the amount of this small reward he will not be arrested.

After increasing the standing reward for the return of deserters to $100, exclusive of necessary expenses, arrangement should be made, whenever possible, with private detective companies of good standing, for constant alertness on their part.

Any one of the reputable detective companies would be glad to enter into arrangements of this sort, although their revenue from this source after the first year would be very small. Desertion is a crime preceded by deliberation and thought, and a certainty of capture would be a most powerful deterrent.

In the case of the army (for the above is more applicable to conditions in the marine corps and navy) the problem of apprehending deserters is more difficult of solution. Except in the case of posts near large cities, the employment of detectives is out of the question, but we believe that the comparatively large reward and its prompt payment upon delivery would help matters very much.

If this be objected to on the ground of expense, it must be remembered that provision is made for checkage of pay in the case of absentees and that after such a law had been in operation for a time, desertion would not be as common as it is now.

These two rather radical changes must be adopted before we proceed. It is of little avail to bring a man to justice, and on what is at best a technicality, acquit him; and it is even of less avail to make laws for the punishment of offenders and then not bring them to justice.

Having made possible the capture and conviction of deserters, we will consider punishments.

Punishments are divided roughly into two classes, *i. e.*, punitive and deterrent, and the kind to be used depends upon the nature of the offense.

For those offenses performed on impulse, under the stress of

passion, punitive punishments are applied, murder and its punishment death, being the extreme of impulsive crime and punitive punishment. Those offenses performed after deliberation and from thought, with the chances of discovery carefully weighed, require deterrent punishments, *i. e.*, punishments of such a character that when known to the prospective criminal from the very inception of the criminal plan, will outweigh the benefits he thinks will be his as a result of his act.

It will be admited, we think, without contention, that desertion is a crime inspired by personal feeling, homesickness, sense of unjust treatment, unstable tastes, etc., and not an act inspired by passion. It would be difficult to divide desertion into "degrees" as is murder divided. It is the result of deliberation and forethought, and the patience with which deserters await the best opportunity for flight, choosing a place where employment and concealment are to be found, proves this conclusively. The neglect to put themselves in communication with federal authority, as provided for in our hypothetical regulation, supplies whatever proof is demanded.

Desertion is a crime which requires a deterrent punishment that will at the same time satisfy the demands of military discipline, and be punitive in its severity.

Let us first consider the present penalties authorized by law. In times of peace the maximum punishment is confinement for two years, with loss of pay and allowances, extra police duties, and dishonorable discharge; at first sight a punishment quite severe enough. Unfortunately in its application, it is not.

Taking the penalties in order: confinement for two years seems severe, but any prisoner who behaves himself and does his light tasks faithfully, has this reduced by five days in every month, so that by behaving as any man can, he will be free at the end of sixteen months. Moreover, a well-behaved man is allowed many privileges, such as visitors, tobacco, books, etc., and is in few ways worse off than his honorable late companion serving at some remote naval station or isolated post. The disgrace of confinement is a factor in weighing a punishment, but is a factor that a disciplinarian need not consider. At those military prisons where solitary confinement is practiced and silence can be enforced at all times, sixteen months is enough.

In imprisoning the great number of deserters that surrender or

are apprehended annually, the navy has hit on a particularly unhappy method. The overflow from the regular naval prisons are sent to a prison ship, and there the confinement amounts to restriction and nothing else.

Imagine a well-found, roomy, well-lighted and heated ship, with navy standards of cleanliness, delightfully situated climatically, and you have the prison ship. Fill it with a ship's company of marines and sailors under ship discipline, eliminate *all* drills, set a mess as good as any in the navy, provide just enough work to keep the prisoners in good health, and you have prison-ship conditions. We are not advocating dirtiness and poor food, darkness and foul air, but if this be confinement, what then is restriction to a ship?

In the prison ship the "silent system" cannot be enforced. Solitary confinement, except for infraction of the prison rules, is impossible. Well fed and happy, the sight of these prisoners loafing in the sun while they work, so demoralized the crews of ships that commanding officers have asked that while at Portsmouth, N. H., their ships be not moored in the vicinity of the U. S. P. S. Southery. This state of affairs, it is hoped, will be of short duration, for money has been appropriated to build a modern prison where work, silence and isolation can be carried out.

Under the present conditions two years is too short a term of confinement and, considering the enormity of the crime of desertion and its far-reaching consequences, a term of five years, reducible to four by good conduct, is recommended.

"Extra police duties" is usually added to sentences carrying confinement, but its meaning, in the absence of a clear definition, is so variously understood, that officers hesitate to use it as a real punishment. The maudlin sentimentality that so closely guards offenders, would bring trouble on the head of any officer who under this expression endeavored to get *work* from prisoners.

Extra police duties in practice has simmered down to requiring only such work of prisoners as the regular enlisted personnel would perform were there present no prisoners. As a punishment it is useless, and is not superfluous in a sentence only because it permits a commanding officer to exercise prisoners for their health's sake.

Nearly all sentences, civil and military, carry work either by custom, implication, or direct statement, but to so limit the amount

and quality of this work by calling it "extra police duty" defeats the object of those who assigned it as a punishment. Unfortunately, because of labor unions, prisons may not be supported by the products of the prisoners' labor, but there is no reason, other than this "police work" limitation, why much heavy work at naval stations and posts, such as ditching, grading, excavating, etc., should not be performed by the labors of military prisoners. Any post commander or commandant could find work for a large number, for this labor, like all enforced labor, is very unsatisfactory when measured by the amount of work done.

Under present laws no work of this kind may be done, and in order that it may be done a change from "extra police duties" to "hard labor" is recommended. This is a real punishment, and a dissatisfied man, contemplating desertion, must and would favorably compare his lot with that of the men working out a sentence for having committing the very crime he is then considering.

Loss of pay and allowances need not be discussed. At present the attitude of the Department in this matter is very liberal. In passing, it would be well to speak of uniforms.

In lieu of allowances, a distinctive prison clothing should be issued, not so conspicuous as to be grotesque, but so unique in coloring that it could be immediately recognized at a distance. Shoes, underclothing and other necessary articles of clothing should be issued to prisoners as required, and, like the uniform, gratuitously.

No change from the present $3 monthly money seems advisable. It is large enough to buy the prisoner many small necessities, and not large enough to amount to pay. The gift of $20 at the expiration of confinement should be continued, for it enables the discharged convict to live until he can obtain employment.

The loss of the voting privilege and debarment from holding office are both proper consequences of dishonorable discharge, for the violator of a solemn oath cannot be expected to be either a good citizen or an honest official. This loss, however, is of little importance, for a man can move to another State and none will question his past. This condition seems irremediable, but civil life can be made hard for him at least in his own town or county by publishing in his city or county papers the fact of his disgrace, and in the case of deserters at large, the reward offered for their return.

Dishonorable discharge is a disgrace, but beyond the command from which the man was discharged, who knows of it? Coming, as it does, at the end of the term of confinement, even his old friends have forgotten the case. The ever-shifting scenes of American life will enable a dishonorably discharged man to live and prosper without the stigma being known.

As a punishment it is valueless and only for sentimental reasons should it be retained if given at the end of imprisonment; but imposed at the beginning, there are many reasons for making it part of the sentence. If a prisoner be dishonorably discharged at the beginning, he then becomes a military *convict* and not a marine or sailor undergoing punishment. As a convict he can be subjected to a more severe discipline and can be more severely punished for violations of the prison rules. In the U. S. Army this is done and works well. Moreover, his place in the service may be filled at once by recruiting a good man. As our military strength is regulated by law, this may not be done, for these men waiting dishonorable discharge must be counted in the authorized strength.

To sum up briefly:

1. We have made possible and probable the apprehension of all deserters.

2. By definition made possible the conviction of deserters.

3. We have increased the punishment until it becomes a real deterrent.

The foregoing remedies may not be the best possible, but it is believed that their adoption would reduce the number of annual desertions to a minimum, for if a deliberate criminal knows that he will be punished he is not likely to commit the crime in mind.

Certainly measures must be taken, and soon, to end a condition which is defeating efficiency, and by its general attack on the very foundation of discipline—obedience—is making a mock of our whole system of military justice.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE BATTLE OF CIUDAD BOLIVAR AND THE END OF THE REVOLUTION IN VENEZUELA.

By Lieutenant Mark St. Clair Ellis, U. S. Navy.

We left Trinidad in the U. S. S. Bancroft on July 10, 1903, for Ciudad Bolivar and other points on the Orinoco river to protect American citizens and interests in Eastern Venezuela. At that time very little was known about the conditions existing there, as President Castro had closed the river to trade in May; the telegraph wires were down, and the whole Orinoco valley cut off from the outside world.

The revolutionists held Ciudad Bolivar and the country for six hundred miles up the river, while Castro's forces occupied the fort of Los Castillos and the villages below it. Three gunboats, one transport and six thousand soldiers had been sent by Castro for a combined attack on Ciudad Bolivar to take place on July 14. The American citizens in that country had not been heard from for over six weeks; three American steamers had been seized by the revolutionists and one by the government.

A trip up the Orinoco appeals to most people, and the excitement of a real live South American war with the chance of recapturing the steamers and rescuing some of our citizens added zest to this one.

We picked up the Barima on the morning of the 13th at the Boca Grande entrance to the Orinoco. The Barima was formerly a Venezuelan man-of-war, which, having become useless as such, was anchored at the Barima bar for a government pilot station and light-ship. Lights were displayed from her whenever the pilots were supplied with kerosene, which was not often. Her sides are thick with scale and her bottom leaky; in trying to keep out the water they have all but filled her holds with cement. After

the river was closed to trade the government forgot to pay the pilots, and they were soon starved out, so that at the time we passed her she was deserted, had drifted from her moorings, and thus left the mouth of the river without a single trustworthy beacon. The land at the mouths of the river is very low and the entrance difficult to recognize even in daytime, and, owing to the lack, at present, of proper aids to navigation, it is unsafe for any but light draft vessels to attempt to cross the bar at night.

The country is low and alluvial for two hundred miles up the river, and many caños or streams pass through it; for most of the year the river overflows its banks and nearly the whole delta is converted into a dense tropical morass. Occasionally on an elevated spot along the river banks one finds an Indian hut or an Indian village; but excepting these there are no signs of human habitation. Huge trees covered with moss and creepers encroach upon the river as far as the current will allow, and the indescribable wildness and grandeur of the scene fills one with wonder. These low lands do not become monotonous, the whole forest is so filled with strange living creatures, and the coloring so diverse and striking that one's interest never flags. The sailor, accustomed to deal sparingly with fresh water, wonders where so much of it comes from, and the traveler only begins to realize the gigantic area of South America. The resources of this rich delta, capable of supporting the whole population of South America, are wonderful; and one cannot but think of a time, it is to be hoped not far distant, when the Orinoco, like the Mississippi, will become the highway of trade for a continent. The Orinoco and the Amazon are already connected by a small stream, and it would be far less costly an undertaking than our Isthmian Canal to make the two rivers navigable to steamers from Barima bar to Joannes Island.

The immense areas comprising the valleys of these two rivers are rich beyond the dreams of avarice; capable of supporting an enormous population, they remain an unbroken, almost unexplored and uninhabited primeval forest.

Venezuelan Guayana alone is larger than Germany and Holland combined; abounding in rubber, hard wood, mineral, agricultural and grazing lands, it has but 40,000 inhabitants, who, with riches within their grasp, remain distressingly poor, due partly to the frequent revolutions that retard the development of the country's resources.

On the morning of the 14th we caught up with and, after an exciting race, passed the French gunboat Jouffroy, bound also for Ciudad Bolivar; as it was Bastile Day we full-dressed ship and at noon fired a salute of twenty-one guns in honor of the French nation; the salute was, of course, returned. It was an impressive sight to see this courtesy of two great nations exchanged in the wild jungle, uninhabited save by a few Indians, the big red monkeys, the parrots, the jaguars, the caribes, the alligators and the other denizens of the forest and stream.

After reaching Barrancas the river narrows and the current becomes very swift; the low lands give place to broad savannas stretching away in the distance to dark green mountains, and the signs of habitation become less infrequent.

We reached Ciudad Bolivar on the morning of the 15th, to find ours the first foreign man-of-war to arrive. Hostilities were about to begin and the foreign colony, so long cut off from the outer world, greeted our ship as a white-winged angel of mercy.

Ciudad Bolivar is a town of 14,000 inhabitants, situated on an elevated point on the south side of the Orinoco river. The river is narrow here, and there is an average rise and fall of over forty feet between high and low water in the wet and dry seasons; it is always navigable as far as Ciudad Bolivar for vessels of sixteen feet draft.

Along the water front, on the north side of the town, is a wide street on which is located the concession containing most of the consulates and residences of the foreigners. On the east side is a narrow levee and a low strip of land which in former times became a lagoon at high water. To the south is a valley sloping for half a mile to a high round hill crowned by a fortress called the Zamora, and a little further on is another similar hill called the Cerro Gordo. To the westward of the Zamora is a valley in which stands the Quartel, or old Spanish barracks. On the west side of the town is a ridge on which is located a large walled cemetery. In the center of the town and on its highest point is an old fortress called the Capitolia. Across the river on the north side, distant about one mile, is a hill on which stands the village of Soledad. The town is well built of adobe and brick in the usual Spanish style. Commercially it is the distributing and shipping point to and from the whole of eastern Venezuela; strategically it is almost ideal for the defense.

The situation upon our arrival was as follows: General Ferreras commanded the revolutionary army of Guayana and General Rolando that of Eastern Venezuela; altogether they had three thousand men strongly fortified in the city. Ferreras cut the levee and flooded the lagoon, thus reducing the area to be defended; but it rendered homeless over two hundred poor people who had built their houses on these low lands. Among those so affected was our good pilot, Raymon Isidro, who on our arrival found his savings for years thus ruthlessly swept away.

The streets were barricaded, many private houses fortified, and every means of defense taken advantage of. The enemy had now to march to the attack over two narrow strips of land, completely commanded by the Zamora, the Quartel, the walled cemetery, the Market, the Capitolia, and the redoubts inside the cut.

The government troops under General Gomez, Vice-President of Venezuela, numbered six thousand; one thousand were in Soledad and the remaining five thousand surrounded the city, their outposts being only half a mile from those of the revolutionists. The gunboats Restaurador Bolivar and Miranda and one transport were anchored below the town, but at daybreak on the 15th the Miranda stole past the fortifications and anchored up stream, thus rendering the siege complete. The gunboats were ready for an attack at 10 A. M., but at the request of Captain Culver, commanding the U. S. S. Bancroft, a delay of one day was obtained in order to take off American and British refugees and to give the French gunboat time to arrive and collect theirs.

Three American steamers of the Orinoco Steamship Company were found in possession of the revolutionists; Captain Culver immediately demanded and obtained their release, and upon being assured that they would not be molested by the government, started them at night for San Felix.

The French gunboat Jouffroy arrived, took off a number of refugees and then anchored several miles below the town. The Bancroft anchored just above Soledad and waited developments.

General Gomez guaranteed full amnesty to all revolutionists who would peacefully surrender, excepting Ferreras, whom the government intended to punish for treason. All of them but Ferreras were willing to surrender, but as he refused to do so without being included in the pardon, they finally agreed to hold out for better terms for him. Captain Culver again obtained a

postponement of hostilities, hoping that a peaceful settlement could be effected and damage to American property avoided.

In this interim Rolando telegraphed direct to President Castro offering to surrender the whole revolutionary army, provided Ferreras be included in the general amnesty, but "if not," he added, "my brave soldiers know how to meet the enemy." Castro replied in a lengthy proclamation declaring that all revolutionists who had borne arms against the government since the foreign allies attacked San Mateo were traitors to their country, and would be treated as such. He annulled Gomez's offer of amnesty and ordered an attack.

All hopes of peace then fled, and it became a partisan war. The revolutionists had had their pride wounded, and Rolando answered this proclamation with a grandiose appeal to arms. The effect on the revolutionists was magical; the officers cast aside swords and took up rifles instead, and every man and boy who could carry arms sprang to the defense.

All the foreign consular officers took refuge on the gunboats, except the American Consular Agent, Mr. Robert Henderson, who resolutely refused to leave his post.

The outposts now began a desultory fire. Both sides were well armed with old-fashioned Mausers and modern field pieces and generously provided with ammunition, the revolutionists alone having 2,500,000 rounds.

Each side carried the Venezuelan flag, and in addition the government troops had a yellow standard and the revolutionists a white. They also wore their colors on their hat bands, and this was the only way of distinguishing one side from the other, as they wore no uniforms. The revolutionists were called the "whites" and the government troops the "yellows."

As there was no flag of truce, it was customary in crossing the lines to carry a white flag until past the revolutionary outposts, then to hoist the yellow flag while within the government lines, and vice versa on the return. An evidence of the influence of the United States felt here was manifest in the fact that our flag was respected by both sides.

The common soldiers of both armies were mostly pæons of mixed Spanish, Indian and Negro blood, ill fed, ragged and dirty. Nearly all were young men and many of them mere children; I saw one company one-half of which was composed of small boys;

some could hardly carry a rifle and were not over eleven years old. No one, upon first observing them, could believe these sorry-looking troops the splendid fighters I now know them to be.

There were heavy rains on the 17th and 18th, and the miserable predicament of the troops in the wet trenches and the bush without shelter or proper food and clothing was such as could not have been borne by the average foreign soldier. But nevertheless, at 4.30 on the morning of the 19th, in a heavy tropical rain, the government troops advanced to within a few yards of the revolutionists' defenses and opened fire. At dawn the rain ceased and showed an almost hand-to-hand conflict, with the whites behind breastworks and the yellows attacking them. The Cerro Gordo marked the southern periphery of a circle of defenses of which the Capitolia was the center. All around this circle the battle raged fiercely at close range. The gunboats opened fire at long range and the field pieces and infantry in Soledad joined in. The strongest attack was made on the Cerro Gordo and the walled cemetery. Finally the yellows could stand the fire from the cemetery no longer, and were repulsed with great loss. As the yellows withdrew, the whites followed up slowly, and the fighting lulled to desultory firing from the outposts and the trenches. In this attack the advantage was with the whites; Colonel Osorio, in command of two hundred yellows at the west of the cemetery, lost sixty in killed and wounded; in other commands the losses were equally heavy; many had reached the cemetery wall only to leave their dead bodies as high-water marks of their splendid courage.

Again at 10 A. M. the yellows sallied forth and drove the whites into their strongholds and strove heroically to dislodge them. This time the gunboat Bolivar closed in, opened a heavy fire on the redoubts at the cut, and dislodged the riflemen there. The yellows would have reached the abandoned redoubts had not the Bolivar been driven away by the field pieces located further up. Once more the yellows were repulsed with such loss that the cleared space around the cemetery now literally ran with blood. The yellows withdrew to their trenches in the bush, the whites followed up, counting their slain by the hundreds.

After this a weaker fire continued until about four o'clock, when the yellows again advanced against the whites, their strongest attack being made on the Cerro Gordo and the south side of

the cemetery. A strong force of yellows passed around the Cerro Gordo and attacked the Zamora. The yellows were driven back from the cemetery and the cut with frightful loss; the whites, seeing their advantage, charged the enemy and followed them to their entrenchments. The whites were returning at sunset exultant with victory, when to their utmost surprise they beheld the yellow flag waving over the Zamora, their strongest fort and the key to the city. The yellows were encouraged by this gain and once more furiously attacked the whites, who took shelter in their strongholds and let the yellows hold their ground. Soon a plan to retake the Zamora was arranged, and at 8 o'clock the Cathedral bells rang out the signal for a general attack upon it; then a desperate hand-to-hand encounter took place between men who in the morning had been friends. Here the whites sustained their greatest loss, as man after man climbed up the parapet only to receive the bayonet or have his skull cloven with the machete for his pains. To regain the Zamora by infantry assault was impossible. The retreat began across ground exposed to a murderous fire from the enemy in all directions save one, and of the eight hundred picked men who marched up to the Zamora's walls only half returned unscathed.

The whites returned to their defenses at 9.30 to find the yellows again upon them. Some of the yellows had crossed the cut and met the whites returning from the Zamora, worn out, dejected and ready to drop from the fatigue of long fighting. Encouraged by the presence of Rolando, these tired men rushed upon the yellows and, in a desperate encounter, cut them to pieces or pushed them into the lagoon.

The cemetery and the Cerro Gordo held out, and midnight found the combatants in much the same position as at daybreak, except that the yellows now held the Zamora. Later we heard that this fort was sold out to the government.

The loss to the yellows in this hard day's fight was six hundred killed and two hundred wounded; the whites lost two hundred and fifty killed and two hundred wounded. Each side fought equally well, but the whites had the advantage of position. The loss of the Zamora sealed the doom of the revolution. The unusually large proportion of killed to wounded can be explained by the fact that the ground where the latter fell was much fought over, and a second bullet often ended the agony the first had caused.

The morning of the 20th opened bright and sunny; heavy firing had been kept up all night, but there was a lull at about 8 o'clock, during which the Bancroft brought off a number of French refugees. It is well these people were brought off, for during that day twenty-eight shells exploded in their house and the outside walls were pock-marked with bullets.

At 8.30 A. M. a spirited general attack began all along the line; the gunboats Bolivar and Restaurador closed in to short distance and stormed the redoubts inside the cut; the field pieces in Soledad opened on the Capitolia, and the Miranda endeavored to dislodge the whites in the Market. The Zamora fort now shelled the Quartel and the cemetery and supported the yellows in their attack on the south side of the town. On the east side at the cut the yellows gained ground; their way was made easy by the superb work done by the Bolivar (a sister ship of our own little Alvarado and Sandoval). The superior manner in which the Bolivar was handled and the rapidity and effectiveness of her fire elicited the warmest praise from every American naval officer present. See went in close along the beach and, under a terrific fusillade at point blank, stuck to her post and cleared the cut for the advance of the yellows. Once across this cut, the yellows took possession of the redoubts abandoned by the whites and held them while reinforcements were coming up. By ten o'clock the yellows had advanced from the eastward as far as the American Consulate, and here occurred such a stubborn resistance by the whites as will challenge the emulation of the brave. The garrison in the Market took shelter behind trees, stone benches, quays and house corners and kept up the fight continuously against the yellows, under the combined fire of the gunboats, the infantry and the shells from Soledad. The yellows finally gained the Market, but only after almost all the defenders had been slain; their fighting blood was up; the only way to dislodge such men was to kill them, and that is what eventually happened.

The yellows attacking the cemetery did not fare so well. Although the whites in the cemetery were exposed to a flank fire from the Zamora, they sought cover behind the tombs, and held their ground until about 4 o'clock in the afternoon, when the Quartel gave way. Finding themselves almost surrounded and the Quartel in charge of the enemy, the whites withdrew through a hole cut in the cemetery wall up along a sunken road to their

breastworks in the town. From these they were dislodged, and it became a house-to-house fight.

The walls of the houses rose above the roofing, which was made of brick tiling; each house was a little fortress in itself. So impetuous was the advance, so determined the defense, that the streets were literally heaped with the dead and dying; it seemed that only those who were killed or mortally wounded were stopped by bullets; the ordinary wound which would invalid a foreign soldier went almost unnoticed by these.

Gradually the defenders' lines contracted, until at nightfall the whites held only the Capitolia and the houses in its vicinity, and here they made their last stand.

The yellows crowded thick into the plaza around the Capitolia and poured in a deadly fire at close range. The carnage here was something awful and the plaza reeked with human blood.

In the confusion and under cover of darkness Ferreras with a few followers broke through the lines and made good his escape. At midnight the firing ceased and the city was in the hands of the government forces.

Quietly and in an orderly manner General Gomez took possession of the town, and on the morning of the 21st all was peaceful. A rigid search began for the revolutionary leaders. Rolando was found in the German Consulate and marched off to the rogue's march with his hands tied behind him. The tired soldiers dropped in their tracks to sleep; the curious and those who had lost relatives sought a look at the dead.

The non-combatants came out of their hiding places; the dead lay decomposing in the streets and on the field. There had been no time to care for the wounded, the burial of the dead could wait.

I turn from the gruesome sight of the dead to mention the sufferings of the wounded. These poor unfortunates had no care or attention whatever paid them until late in the morning after the battle was over. There was no hospital corps in either army. The pitiful sight of the many badly wounded men who lay uncared for in the hot sun, without even a drop of water to cool their thirst is beyond my power of description and unimaginable by those who have not seen such warfare. Many were brought in by our sailors to an impromptu hospital set up by our surgeon and given attention. Had surgical aid reached them in time

most of them would have lived, but they were faint with loss of blood and lack of the simplest care. Perhaps this apparent inhumanity may be accounted for by the people being used to a hard and miserable life; certain it is that the battle raged so fast and furious that the participants had no time to bury the dead or even care for the wounded. The dead were finally carted off and burned; some were too badly decomposed to move and were cremated as they lay in the streets. The reader will revolt at a description of the many hundreds of dead and the scores of badly wounded soldiers lying uncared for by their side. No accurate list of casualties will ever be obtained; the whites disbanded, and in fact neither side possessed an accurate muster roll. The Venezuelan official report announces 1200 killed and 400 wounded, but having twice gone over the field, and once with a company of sailors, I believe that the losses were underestimated.

No better view of the whole battle could possibly have been obtained than that from our ship, which was so close to the shore that individuals could be recognized through the glass. The ship was frequently struck by bullets, which added the spice of personal danger to the picturesque tragedy we beheld.

I have not mentioned the number of horses and mules killed; they were numbered by the hundreds. One old sore-backed gray mule I watched all day long grazing in the thick of the fray; the shells burst thickly about him, but after the battle I saw him still grazing and unhurt.

In the description of battles accounts of individual heroism form an interesting chapter, for while even a coward will press to the front in a bloody charge, it takes true bravery to stand single-handed and fight against tremendous odds. I saw many cases of individual bravery, and of the others I relate I am too reliably informed to admit of doubt.

In the first attack on the cemetery one yellow advanced ahead of the rest, shoved his rifle through a loop in the wall and continued firing until he fell pierced by many bullets. By a singular fatality his body was too badly decomposed to be carted off, so that on the 22d I again saw him being cremated where he lay. One white took his stand behind a stone embankment along the water front near the American Consulate and, in the face of a tremendous fire from the gunboats, the infantry and Soledad, stood his post all day long, fighting like a tiger at bay. He was

eventually killed, but not before he had expended at least seven hundred rounds of ammunition. Not far from this man was another who, partly sheltered by the corner of a house, almost single-handed kept the yellows back; eventually he was riddled with bullets, but as if scorning defeat or surrender, his hand, rigid in death, still grasped the rifle from which he had fired over five hundred rounds.

In the previously mentioned encounter which took place near the water front, one white rushed upon and slew three of the enemy with his machete and escaped unhurt. In the house-to-house fight which occurred near the end of the battle, men fought so closely that the powder scorched the clothes of the combatants. That the young boy soldiers fought courageously was evidenced by the number wounded and by their dead bodies littering the field. I saw one yellow standard-bearer advance and plant his colors on a rock on which waved the emblem of the whites. In the attempt to haul down the enemy's flag, near which he had placed his own, his body fell never to rise again.

I have already mentioned the splendid fight put up by the gunboat Bolivar; her conduct in this battle deserves to raise the little Venezuelan navy in the eyes of the world.

The pathetic scenes after the battle cast a lurid shade over the thrilling and heroic ones during its progress; scarcely a Venezuelan family escaped without losing one of its members, but the losses, as is always the case in war, fall heaviest on the poor. An elderly lady refugee on board our ship wrung her hands at the sight of the dead and wounded pæons and said, "All these poor peace-loving people butchered and not a single 'general' hurt."

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RIFLING.

By PHILIP R. ALGER, Professor, U. S. Navy.

The object of rifling is to cause the projectile to travel point first through the air without wabbling. To obtain this result, the form and twist of the rifling grooves, and the dimensions and position of the rotating band, must be such that the projectile leaves the gun with its axis practically coincident with that of the bore, animated with a rotation of suitable velocity about that axis, and having no other material angular velocity.

PITCH OF RIFLING.—The pitch of rifling is either constant, in which case its developed curve is a straight line, or increasing, in which case its developed curve is usually a parabola. It is usually defined by the number of calibers of travel along the gun's axis which would correspond to one complete revolution of the groove, as, for example, a rifling beginning with 1 turn in 180 calibers and ending with 1 turn in 30 calibers.

The final pitch which will insure stability in flight for any given projectile can only be fixed empirically: To compute its value we must know the moment of the total air resistance about a transverse axis through the center of gravity of the projectile, which we cannot with our present knowledge determine. In modern practice the final pitch of the rifling of high-power guns is 1 turn in from 30 to 25 calibers, the corresponding angle of the grooves with the axis of the bore being from 6° to 7°; while with guns used for high-angle fire it is somewhat greater, even as much as 1 turn in 15 calibers in the case of mortars firing very long shell.

EQUATION OF DEVELOPED GROOVES.—The first step in the rifling of a gun consists in laying down the developed curve of the groove, and for this purpose its equation must be found.

If the pitch is to be constant, the equation is $y = kx$, in which k is the tangent of the inclination (ϕ_2) of the groove, and, if the groove is to make a turn in n calibers advance, $\tan \phi_2 = \frac{\pi}{n}$, so that the equation is

$$y = \frac{\pi}{n} x \tag{1}$$

If the pitch is to be uniformly increasing, the developed curve is a common parabola and its equation is $y = kx^2$, in which k must be determined so that the pitch shall increase from 1 turn in n_1 calibers at the beginning of the rifling to 1 turn in n_2 calibers at the muzzle. Then, if x_1 and x_2 are the abscissas of the ends of that part of the curve $y = kx^2$ which is the development of the groove, so that $x_2 - x_1 = U$ is the length of the rifled bore, since $\frac{dy}{dx} = \tan \phi = 2kx$, we have $\tan \phi_1 = \frac{\pi}{n_1} = 2kx_1$; $\tan \phi_2 = \frac{\pi}{n_2} = 2kx_2$; and, by subtraction, $2k(x_2 - x_1) = 2kU = \frac{\pi}{n_2} - \frac{\pi}{n_1}$; whence $k = \frac{\pi}{2U}\left(\frac{1}{n_2} - \frac{1}{n_1}\right)$ and $x_1 = \frac{n_2}{n_1 - n_2} U$. Therefore the equation for this case is

$$y = \frac{\pi}{2U}\left(\frac{1}{n_2} - \frac{1}{n_1}\right) x^2 \tag{2}$$

and the rifling begins at $x = \frac{n_2}{n_1 - n_2} U$ and ends at $x = \frac{n_1}{n_1 - n_2} U$.

If the pitch is to be zero at the beginning of the rifling, $n_1 = \infty$, and (2) reduces to $y = \frac{\pi}{2Un_2} x^2$, the rifling then beginning at $x = 0$ and ending at $x = U$.

If the pitch is to increase at a diminishing rate from 1 turn in n_1 calibers at the beginning to 1 turn in n_2 calibers at the muzzle, the developed curve may be taken to be a semi-cubical parabola, in which case its equation is $y = kx^{\frac{3}{2}}$. Then since $\frac{dy}{dx} = \tan \phi = \frac{3k}{2} x^{\frac{1}{2}}$, we have $\tan \phi_1 = \frac{\pi}{n_1} = \frac{3k}{2} x_1^{\frac{1}{2}}$ and $\tan \phi_2 = \frac{\pi}{n_2} = \frac{3k}{2} x_2^{\frac{1}{2}}$; whence we find $k = \frac{2\pi}{3n_1 n_2} \sqrt{\frac{n_1^2 - n_2^2}{U}}$ and $x_1 = \frac{n_2^2}{n_1^2 - n_2^2} U$. Therefore the equation for this case is

$$y = \frac{2\pi}{3n_1 n_2} \sqrt{\frac{n_1^2 - n_2^2}{U}} x^{\frac{3}{2}} \tag{3}$$

and the rifling begins at $x = \frac{n_2^3}{n_1^3 - n_2^3} U$ and ends at $x = \frac{n_1^3}{n_1^3 - n_2^3} U$.

If the pitch is to be zero at the beginning, $n_1 = \infty$ and (3) reduces to $y = \frac{2\pi}{3n_2 U^{\frac{1}{3}}} x^{\frac{1}{3}}$, the rifling then beginning at $x = 0$ and ending at $x = U$.

In a similar way the equation to the developed groove may be found if it is a circular arc, or has any other specified form.

The final pitch being fixed, two considerations should govern the selection of the curve of the rifling;—(1) The maximum pressure between the driving edges of the grooves and the rotating band must not be so great as to shear or crush the bearing surfaces of the band; (2) the frictional resistance to motion along the bore caused by the rifling should be as small as practicable. So far as the strength of the gun is concerned the effects upon it of the forces developed by the action of the rifling are so small as to be negligible.

These conditions, however, are contradictory, since, as will be shown, the frictional resistance is least with a constant pitch rifling, while the maximum rotating force is least when the pitch increases at such a rate as to cause the rotating force to be constant.

THE ROTATING FORCE.—We will deduce the general expressions for the rotating force and the frictional resistance, and then apply them to particular cases.

Let m be the mass of the projectile, ρ its radius of gyration (about the axis of rotation), v its velocity of translation, ω its angular velocity, and G the total pressure on its base; a being the radius of the bore, ϕ the inclination of the grooves, and μ the coefficient of friction. Also let Q be the sum of the radial pressures between gun and rotating band (due to the compression of the latter), and R the sum of the tangential pressures, normal to the driving edges of the grooves, both these forces being uniformly distributed around the circumference.

Then the total frictional resistance is $\mu(Q + R)$, and being directly opposed to the motion of the rotating band (which slides down the grooves), has a component $\mu(Q + R) \sin \phi$, which resists the rotation of the projectile, as well as a component $\mu(Q + R) \cos \phi$, which resists its motion of translation.

Figure 1 represents a rifling groove and its developed curve, an element of the bore OA being taken as the X axis and the beginning of the rifling O as the origin; ϕ_1 is the initial inclination, ϕ_2 the final inclination, and ϕ the inclination at any point P whose coordinates (in the developed curve) are $x = OM$, $y = MP = OP' = a\theta$. Then the angular velocity and acceleration of the projectile are $\frac{d\theta}{dt}$ and $\frac{d^2\theta}{dt^2}$, its velocity and acceleration along the bore being $\frac{dx}{dt}$ and $\frac{d^2x}{dt^2}$; and, resolving all the forces in the direction of the axis of the bore and circumferentially, we have at each instant of the projectile's travel in the gun:*

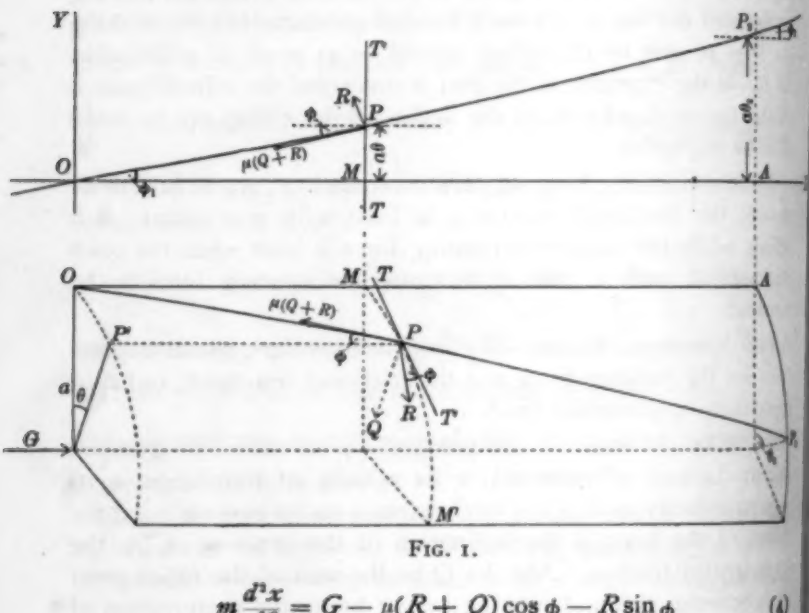

FIG. 1.

$$m\frac{d^2x}{dt^2} = G - \mu(R+Q)\cos\phi - R\sin\phi \qquad (4)$$

$$m\rho^2\frac{d^2\theta}{dt^2} = a[R\cos\phi - \mu(R+Q)\sin\phi] \qquad (5)$$

* In the figure the forces R, Q and $\mu(R+Q)$ are represented as acting at the point P; actually, of course, the forces at P are $\frac{R}{n}$, $\frac{Q}{n}$ and $\frac{\mu(R+Q)}{n}$ where n is the nmber of rifling grooves, and n equal sets of such forces act at the equidistant points where the grooves meet the circumference MPM'.

From (5) we get

$$R = \frac{\frac{m\rho^2}{a}\frac{d^2\theta}{dt^2} + \mu Q \sin\phi}{\cos\phi - \mu \sin\phi} \tag{6}$$

Then, if the equation to the developed curve is $y = f(x)$, we have by differentiation, since $y = a\theta$,

$$\frac{d\theta}{dt} = \frac{1}{a} f'(x) \frac{dx}{dt} \tag{7}$$

$$\frac{d^2\theta}{dt^2} = \frac{1}{a}\left[f'(x) \frac{d^2x}{dt^2} + f''(x)\left(\frac{dx}{dt}\right)^2\right] \tag{8}$$

and, substituting in (6), we obtain

$$R = \frac{\frac{m\rho^2}{a^2}\left[f'(x) \frac{d^2x}{dt^2} + f''(x)\left(\frac{dx}{dt}\right)^2\right] + \mu Q \sin\phi}{\cos\phi - \mu \sin\phi} \tag{9}$$

which, after replacing $\frac{d^2x}{dt^2}$ by its value from (4), and putting v for $\frac{dx}{dt}$ and $f'(x)$ for $\tan\phi$, reduces to

$$R = \frac{\frac{\rho^2}{a^2}\sqrt{1+f'(x)^2}\,[Gf'(x) + mv^2 f''(x)] + \mu Q f'(x)\left[1 - \frac{\rho^2}{a^2}\right]}{1 - \mu f'(x)\left[1 - \frac{\rho^2}{a^2}\right] + \frac{\rho^2}{a^2} f'(x)^2} \tag{10}$$

Whatever be the form of the rifling, if we know the equation of its developed curve and the values of G and v in terms of x, (10) will give us the value of the total tangential force, normal to the driving edges of the grooves, at any point of the projectile's travel in the bore.

Since moving the X axis parallel to itself merely changes the ordinates of the curve by a constant quantity, it is not necessary that the equation of the developed groove should be referred to the beginning of the rifling as origin, provided the X axis is parallel to an element of the bore, but *the values of x used in* (10) *must always be measured from the origin of coordinates.*

THE FRICTIONAL RESISTANCE.—The total resistance of friction being $\mu(R + Q)$ and directed along the grooves, the work done against it, and therefore wasted, is given by

$$E_f = \int_0^U \mu(R + Q) \sec\phi \, dx = \int_0^S \mu(R + Q) \, ds \tag{11}$$

in which U is the length of the rifled bore and S the length of a groove.*

If $R + Q$ has a constant value, (11) reduces to

$$E_f = \mu(R + Q)S \tag{12}$$

and the same expression is true even when one or both of R and Q are variable in value, provided we give them their mean values. This shows the importance of making the mean values of both R and Q as small as practicable.

THE PROFILE OF THE GROOVE.—The value of Q, the total radial pressure between gun and rotating band, should depend solely upon the "forcing," that is upon how much of the metal of the band is displaced when the projectile is forced into the rifled part of the bore, and it should not be increased by the rotation of the

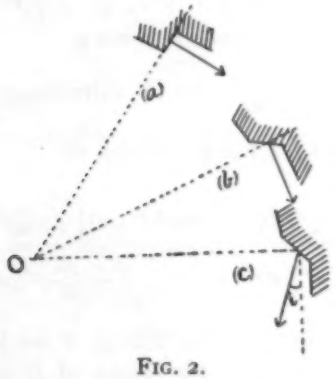

FIG. 2.

projectile. To accomplish this, the profile of the driving edge of the groove should either contain a radius of the bore, as shown in figure 2 (a), or should make with the radius an angle not greater than the angle of friction, as shown in figure 2 (b), since thus the resultant of the pressure between the driving edge and the rotating band will be in a plane tangential to the bore and will be entirely effective in giving rotation. Should the profile of the driving edge make with the radius a greater angle than $\tan^{-1}\mu$, the resultant pressure would be inclined to the tangent plane, as shown in figure 2 (c), and only its resolved part in the tangent

* If the origin of coordinates is not coincident with the beginning of the rifling, $E_f = \int_{x_1}^{x_2} \mu\ (R+Q)\ \sec\phi\, dx$, in which x_2 and x_1 are the abscissas of the ends of that part of the curve which is the development of the groove, so that $x_2 - x_1 = U$.

plane $\left(\frac{R'}{n}\cos i\right)$ would be effective, the radial component merely compressing the band and increasing the frictional resistance to motion.

We will assume the profile of the grooves to be such that the resultant action of each driving edge is in a tangential plane, as it should be.

THE FORCING.—Besides giving rotation to the projectile, the band serves the purpose of a gas check, preventing the free escape of gas past the projectile and the consequent loss of energy and rapid erosion of the bore, and to this end it is made of a diameter exceeding the diameter of the gun from groove to groove. Thus, in U. S. Naval guns, which have rifling grooves 0.05″ deep, the diameter of the rotating bands is from 0.12″ to 0.16″ greater than the caliber, with a view to their maintaining a close contact with the bottom of the grooves when the bore is expanded by the powder pressure.

The forcing of the band also serves useful purposes, (*a*) by delaying the first motion of the projectile until the pressure in the chamber has risen to a point which insures the complete inflammation of the charge, (*b*) by the hardening effect of the compression upon the metal of the band, increasing its resistance to the crushing action of the driving edges of the rifling. The increased muzzle velocity which results from excessive forcing can, however, be obtained with less strain upon the gun by the use of a quicker powder, and weakness of the rotating band is best remedied by increasing either its width or the number of rifling grooves.

The maximum diameter of the band, then, should only exceed the diameter of bore from groove to groove by an amount equal to, or very slightly greater than, the expansion of the bore under the action of the powder pressure, *i. e.* from 0.015″ to 0.03″ according to the caliber. Moreover, the width of groove should be at least twice the width of land, and the wider the rotating band the more important is it to make the lands narrow.

THE VALUE OF μQ.—Such experimental measurements as have been made of the pressures required to force banded shell through the bores of rifled guns indicate very high values for the total radial pressure (Q) between bore and band,* but to what extent

*See "Report of Tests of Metals made at Watertown Arsenal, Mass., 1896," for measurements of the resistance of banded shell to being forced through the bores of rifled guns.

this condition is altered when the bore is expanded by the powder pressure and when, instead of being very slowly forced into and through the bore, the projectile starts with a great acceleration and moves with high velocity, we do not know. There is little doubt, however, that in the case of many, if not most, guns and projectiles of modern design, a pressure in the neighborhood of two tons per square inch on the base of the projectile is required to force it into the rifling, and a pressure little if any below one ton per square inch to overcome the frictional resistance to its further motion through the bore, and this independent of the force required to overcome the friction caused by the rotating action of the rifling.

When the rifling is of increasing pitch, the distortion of the metal of the band due to the changing inclination of the lands must add considerably to the resistance to the motion of the projectile, but including this in the frictional resistance designated by μQ, and supposing the latter to have a mean value of q tons per square inch of the projectile's base, or $\mu Q = \pi a^2 q$ tons, we may say that with increasing pitch and considerable forcing the value of q is about one, while with uniform twist and the lightest practicable forcing its value is probably at least one-half.

THE VALUE OF R.—Returning now to the general expression (10) for the total tangential force, normal to the driving edges of the grooves, if we take $\mu = \frac{1}{6}$ and $\frac{\rho^2}{a^2} = \frac{1}{2}$, values from which they cannot greatly depart,* it will be found that the denominator $\left(1 - \mu \tan\phi \left(1 - \frac{\rho^2}{a^2}\right) + \frac{\rho^2}{a^2}\tan^2\phi\right)$ passes from unity through a minimum 0.9966 to unity again when the value of $\tan\phi$ passes from 0 to $\frac{1}{6}$ (ϕ from 0° to about 9°), so that no appreciable error will result from putting unity for that denominator. Moreover, since even for a value of ϕ corresponding to 1 turn in 22 calibers the value of $\sec\phi$ is only 1.01, while for an average value of ϕ it

* The value of $\frac{\rho^2}{a^2}$ for A. P. projectiles is almost exactly ½, and even for common shell of large capacity it seldom reaches $\frac{2}{3}$, but within the limits of any probable values of $\frac{\rho^2}{a^2}$ and of the coefficient of friction μ, the quantity $1 - \mu \tan\phi \left(1 - \frac{\rho^2}{a^2}\right) + \frac{\rho^2}{a^2}\tan^2\phi$ differs very little from unity for any value of ϕ less than 8° or 9°, and practically ϕ never exceeds 9°.

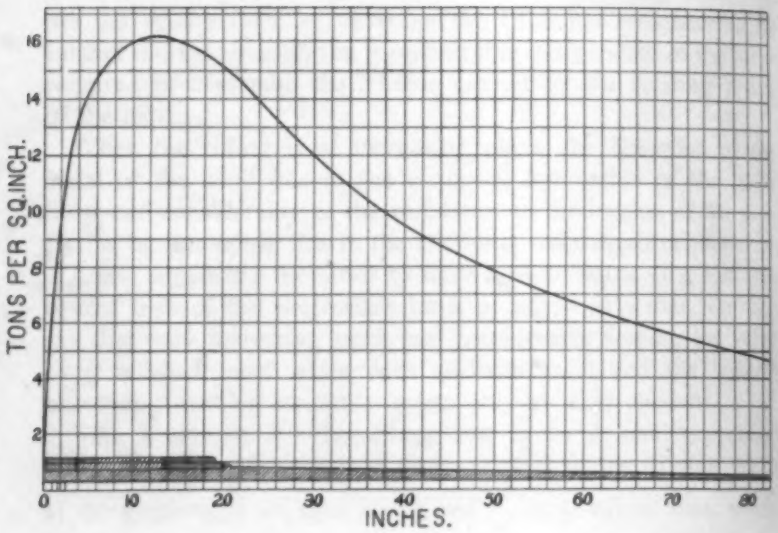

FIG. 3.

Gas Pressure on base of Projectile.

Gun	10 c. m.
Projectile	14.1 kilos.
Charge	2.0 "
Density of loading	.423
Velocity at 43 met.	566 met.

does not exceed 1.004, we may also put unity for $\sqrt{1+f'(x)^2} = \sec\phi$, and thus, in place of (10), write with substantial accuracy

$$R = \frac{\rho^2}{a^2}\left[Gf'(x) + mv^2 f''(x)\right] + \mu Q f'(x)\left[1 - \frac{\rho^2}{a^2}\right] \quad (13)$$

CONSTANT PITCH RIFLING.—If the inclination of the groove has the constant value ϕ_2, the equation to its developed curve is by (1) $y = x \tan\phi_2$. Therefore, for this case, we have $f'(x) = \tan\phi_2$, $f''(x) = 0$, and (13) reduces to

$$R = \left[\frac{\rho^2}{a^2} G + \left(1 - \frac{\rho^2}{a^2}\right)\mu Q\right]\tan\phi_2 \quad (14)$$

or, with sufficient approximation for practical purposes, putting $\frac{\rho^2}{a^2} = \frac{1}{2}$, $G = \pi a^2 g$ and $\mu Q = \pi a^2 q$,

$$R = \frac{\pi a^2}{2}\left(g + q\right)\tan\phi_2 \quad (15)$$

in which a must be expressed in inches, g is the gas pressure on the base of the projectile in tons per square inch, q is the tons per square inch on the projectile's base necessary to overcome the friction without rotation, and R is given in tons.

If, for example, we suppose the 10 cm. gun whose pressure curve, as given by a spring gauge, is shown in figure 3 to be rifled with a constant twist of 1 turn in 25 calibers, we have $\pi a^2 = 12.508$ square inches and $\tan\phi_2 = \frac{\pi}{25}$, whence by (15), taking $q = \frac{3}{4}$, $R = .786(g + \frac{3}{4})$ tons, from which and the pressure curve we form the following table of values of R.

x (inches).	g (tons per sq. in.)	R (tons).
0	1.0	1.4
1	7.0	6.1
2	9.5	8.1
5	14.2	11.7
10	16.0	13.2
13	16.2 maximum.	13.3 maximum.
20	15.2	12.5
30	12.0	10.0
40	9.5	8.1
50	7.8	6.7
60	6.6	5.8
70	5.6	5.0
80	4.8	4.4
82.6 muzzle.	4.6	4.2

CONSTANTLY-INCREASING PITCH.—If the pitch increases at a constant rate, the equation to the developed grooves is by (2) $y = kx^2$, whence $f'(x) = 2kx$ and $f''(x) = 2k$. Therefore, for this case, (13) reduces to

$$R = 2kx\left[\frac{\rho^2}{a^2}\,G + \left(1 - \frac{\rho^2}{a^2}\right)\mu Q\right] + 2k\,\frac{\rho^2}{a^2}\,mv^2 \qquad (16)$$

or, with sufficient approximation, putting $\frac{\rho^2}{a^2} = \frac{1}{2}$, $G = \pi a^2 g$ and $\mu Q = \pi a^2 q$,

$$R = k[\pi a^2(g + q)x + mv^2] \qquad (17)$$

in which by (2) $k = \frac{\pi}{2U}\left(\frac{1}{n_2} - \frac{1}{n_1}\right)$; a must be expressed in inches; g is the gas pressure on the base of the projectile in tons per square inch; q is the tons per square inch on the projectile's base necessary to overcome the friction without rotation; m is the projectile's weight in tons divided by 32.2; v is the velocity of the projectile in f. s.; and x and U must be expressed in feet, the rifling beginning at $x = \frac{n_2}{n_1 - n_2}\,U$ and ending at $x = \frac{n_1}{n_1 - n_2}\,U$.

If, for example, the 10 cm. gun whose pressure curve is shown in figure 3 has ordinary parabolic rifling of pitch increasing from zero at the beginning to 1 turn in 25 calibers at the muzzle, where $U = 6.88$ feet, we have $k = \frac{\pi}{50 \times 6.88} = .009132$. Also, the projectile weight being 31 pounds, we have $m = \frac{31}{32.2 \times 2240} = .0004298$ tons, and, since $\pi a^2 = 12.508$ square inches, we find from (17), taking $q = 1$ for this case, $R = .1142(g + 1)x + .000003925\,v^2$ tons; from which and the pressure and velocity curves we form the following table of values of R.

x (feet).	g (tons per sq. in.)	v (f. s.)	R (tons).
0	1.0	0	0
.0833	7.0	139	0.2
.1667	9.5	225	0.4
.4167	14.2	467	1.6
.8333	16.0	752	3.8
1.0833	16.2 maximum.	886	5.2
1.6667	15.2	1132	8.1
2.5000	12.0	1375	11.1

3.3333	9.5	1537	13.3
4.1667	7.8	1652	14.9
5.0000	6.6	1740	16.2
5.8333	5.6	1809	17.2
6.6667	4.8	1865	18.1
6.8800 muzzle.	4.6	1878	18.2

PITCH INCREASING WITH DIMINISHING RATE.—If the pitch is an increasing one, but with a diminishing rate of increase, the equation to the developed groove is $y = kx^{\frac{1}{2}}$, whence $f'(x) = \frac{3k}{2}x^{\frac{1}{2}}$ and $f''(x) = \frac{3k}{4x^{\frac{1}{2}}}$. Therefore, for this case, (13) reduces to

$$R = \frac{3kx}{2}\left[\frac{\rho^2}{a^2}\,G + \left(1 - \frac{\rho^2}{a^2}\right)\mu Q\right] + \frac{3k}{4}\,\frac{\rho^2}{a^2}\,\frac{mv^2}{x^{\frac{1}{2}}} \qquad (18)$$

or, with sufficient approximation, putting $\frac{\rho^2}{a^2} = \frac{1}{2}$, $G = \pi a^2 g$ and $\mu Q = \pi a^2 q$,

$$R = \frac{3k}{4}\left[\pi a^2\,(g + q)x^{\frac{1}{2}} + \frac{mv^2}{2x^{\frac{1}{2}}}\right] \qquad (19)$$

in which by (3) $k = \frac{2\pi}{3n_1n_2}\sqrt{\frac{n_1^2 - n_2^2}{U}}$; a must be expressed in inches; g and q are in tons per square inch; m is tons mass; v is f. s.; and x and U must be expressed in feet, the rifling beginning at $x = \frac{n_2^2}{n_1^2 - n_2^2}\,U$ and ending at $x = \frac{n_1^2}{n_1^2 - n_2^2}\,U$.

If, for example, the 10 cm. gun whose pressure curve is shown in figure 3 has semi-cubical parabolic rifling of a pitch increasing from zero at the beginning to 1 turn in 25 calibers at the muzzle, where $U = 6.88$ feet, we have $k = \frac{2\pi}{3n_2U^{\frac{1}{2}}} = \frac{6.2832}{75\sqrt{6.88}} = .03194$. Also $m = \frac{31}{32.2 \times 2240} = .0004298$ tons, and, since $\pi a^2 = 12.508$ square inches, we find from (19), taking $q = 1$ for this case, $R = .2996(g + 1)x^{\frac{1}{2}} + .000005148\,\frac{v^2}{x^{\frac{1}{2}}}$ tons, from which and the pressure and velocity curves we form the following table of values of R.

x (feet).	g (tons per sq. in.)	v (f. s.)	R (tons).
0	1.0	0	0
.0833	7.0	139	1.0
.1667	9.5	225	1.9
.4167	14.2	467	4.7
.8333	16.0	752	7.8
1.0833	16.2 maximum	886	9.2
1.6667	15.2	1132	11.4
2.5000	12.0	1375	12.3
3.3333	9.5	1537	12.4
4.1667	7.8	1652	12.3
5.0000	6.6	1740	12.1
5.8333	5.6	1809	11.8
6.6667	4.8	1865	11.4
6.8800 muzzle.	4.6	1878	11.2

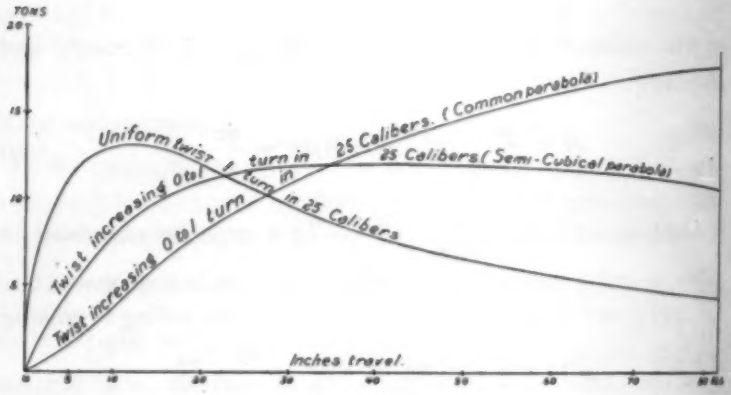
TONS
Uniform twist 1 turn in 25 Calibers. (Common parabola)
25 Calibers (Semi-Cubical parabola)
Twist increasing 0 to 1 turn in 25 Calibers
Twist increasing 0 to 1 turn
Inches travel.

FIG. 4.

In order that the rotating pressures in the three cases considered, each having the same final pitch, may be readily compared, they are represented in figure 4, the ordinates of which are the values of R in tons and the abscissas the travel of the projectile in inches. As shown by (15), the curve for constant twist is similar to the powder pressure curve, the maximum value of R being concurrent with the maximum powder pressure. With the common-parabolic rifling, on account of the term containing v^2, the value of R increases all the way to the muzzle. With the semi-cubical parabolic rifling, though R reaches its maximum value much later in the travel than it does with constant pitch rifling,

yet, because the term in v^2 is divided by x^1, it remains nearly constant after attaining its maximum value.

In similar guns of different calibers, at corresponding points in the bore, the value of R is proportional to the square of the caliber with all forms of rifling.

WORK LOST IN OVERCOMING FRICTION.—As shown by (11), the work done in overcoming friction is the sum of the two integrals $\int_0^U \mu Q \sec\phi\, dx$ and $\int_0^U \mu R \sec\phi\, dx$, of which the first takes account of the resistance due to the forcing and the second of that due to the rotating action of the rifling.

On our assumption that the mean value of μQ is $\pi a^2 q$ tons, and calling sec ϕ unity, which we may do without material error, the work of overcoming the friction due to the forcing is $\pi a^2 q U$, in which, as already stated, q has a probable value of about one for the usual amount of forcing and with increasing twist, while with constant twist its value is somewhat less. Thus, in the case of the 10 cm. gun previously considered, this part of the work of overcoming the friction was taken to be $12.508 \times 6.88 = 86.1$ foot tons in the two cases of increasing pitch rifling, while in the case of constant pitch rifling, for which g was given the value $\frac{3}{4}$, it was taken to be $12.508 \times \frac{3}{4} \times 6.88 = 64.6$ foot tons.

As regards the work done in overcoming the friction caused by the rotation of the projectile, again calling sec ϕ unity, it will be seen that this is μ times the area under the curve whose ordinates are values of R and abscissas travel of the projectile. In other words this work is simply the mean value of R multiplied by the coefficient of friction and the whole travel.

Thus, for example, the areas under the three curves shown in figure 4 are respectively 57.1, 82.2 and 74.8 (the abscissas being taken in feet), and so, taking $\mu = \frac{1}{5}$, the work lost in overcoming the friction is $\frac{57.1}{5} = 11.4$ foot tons with constant twist, $\frac{82.2}{5} = 16.4$ foot tons with the common-parabolic rifling, and $\frac{74.8}{5} = 15.0$ foot tons with semi-cubical parabolic rifling.

Supposing the pressure curve to give the true gas pressure on the base of the projectile, the total work done on the latter was 844 foot tons; if the rifling is of increasing pitch, about 10.2% of this is lost in overcoming the friction due to the forcing and from 1.78% to 1.94% (according to which form of parabola is

taken for the developed groove) in overcoming the friction due to the rotating action of the rifling; the remainder appears as the muzzle energy of the projectile. If, however, the rifling be of constant pitch, considerably less work is required to overcome the friction due to the forcing (we assume it to be only $\frac{3}{4}$ as much, or 7.65% of the total work), and the work of overcoming the friction due to the rotating action of the rifling is only 1.35%.

EXPERIMENTAL DATA.—The following experimental results, bearing on the question of the friction caused by rifling, were obtained by Captain Noble.* Three 12 cm. guns, alike in all other respects, were rifled with grooves of the same profile; one with no twist; the second with constant twist of 1 turn in 35 calibers; and the third with twist increasing from 1 in 102 to 1 in 35 calibers, the developed groove being a semi-cubical parabola. As the mean of 15 rounds from each gun, using the same powder charge, the muzzle energies were respectively 1408, 1387 and 1356 foot tons, showing a loss of 1.52% due to the constant pitch rifling and a loss of 3.78% due to the increasing pitch rifling. The difference of energy in favor of constant over increasing twist, 31 foot tons, as will be seen from our previous discussion, is only partly due to the less friction from the rotating action; the greater part of the difference is probably due to the fact that with the constant twist no further distortion of the rotating band occurs after it has once fully engaged the rifling.

THE NUMBER AND DEPTH OF GROOVES.—As a general rule the number of grooves is proportional to the caliber, and their depth is the same for all calibers; for example, the U. S. sea-coast artillery guns have six grooves per inch of the caliber, 0.06″ deep, while U. S. naval guns have four grooves per inch of caliber, 0.05″ deep.† This practice, however, is only justifiable if the width of the rotating band is increased proportionally to the caliber. For, since the value of R increases with the square of the caliber, the bearing surface between band and driving edges should increase in the same ratio, which it does not do unless

*These experiments are described in "Notes on the Construction of Ordnance . . . , No. 60." Ordnance Department, U. S. A. The powder used was an amide powder, which while not entirely smokeless, gave much less smoke and fouling of the bore than ordinary gun powders.

†This does not apply to guns using fixed ammunitions, as in them it is necessary to limit the depth of the grooves and this makes it necessary to increase their number relatively.

either width of band or depth of groove, as well as number of grooves, is made proportional to caliber.

This is the most serious objection to the use of increasing twist rifling, that with it a broad rotating band cannot be used without excessive frictional resistance and increased liability to stripping.

Let n be the number of grooves, d their depth in inches, b the width in inches of the bearing part of the rotating band, and f its strength in tons per square inch to resist crushing. Then in order that the driving edges may not strip the band, we must have $nbdf$ equal to or greater than the maximum value of R. But the maximum value of R for the 10 cm. gun, with constant pitch rifling, was 13.3 tons, or, allowing for an increase of powder pressure, we will say 15 tons for a 4-inch gun. Therefore, for a gun of radius of bore a, the maximum value of R would be $\frac{15a^2}{4}$, and if we make $n = 12a$ and $d = 0.05''$, so that there are six grooves to the inch of caliber, each $0.05''$ deep, we shall have $12a \times .05\, bf = \frac{15a^2}{4}$. Whence, allowing f to have the value 15 tons per square inch, we obtain $b = \frac{5}{12}a$, or the width of the bearing surface of the band should be $\frac{5}{24}$, or say $\frac{1}{5}$, the caliber.

If there be but 4 grooves per inch of caliber, the width of band should be half as great again, or $\frac{3}{10}$ the caliber, unless the material of the band can be supposed to safely bear a greater crushing pressure than 15 tons per square inch.

Slipping of the band in its seat around the projectile, as well as the stripping or shearing of its outer surface, must be prevented, and to this end the band seat should be scored, parallel to the axis of the projectile, with cuts or notches not greatly less in number and depth than the rifling grooves of the gun. The frictional resistance to slipping of the band is always very considerable, but it should not be relied upon altogether, even in the case of small caliber projectiles, much less in the case of those of large caliber. If the width of bands was proportional to the caliber, which the common use of increasing twist rifling has prevented from being the case, the radial pressure between bore and band would probably vary approximately as the square of the caliber, and then the frictional resistance to slipping of the band would

have the same relative value for all calibers. Actually, the larger bands are relatively less wide than the smaller ones, and so the greater the caliber the less friction can be relied upon to prevent slipping.

THE THROWING OFF OF ROTATING BANDS.—Let r be the mean radius of a band, b its width, t its thickness, m the mass of unit volume of its material, and ω the angular velocity of rotation. Then the centrifugal force acting upon the elementary volume $btrd\theta$ is $(mbtrd\theta)r\omega^2$, and its resolved part perpendicular to any diametral plane (that of the X axis in Fig. 5) is $(mbtrd\theta)r\omega^2$

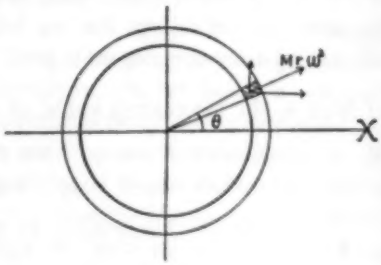

FIG. 5.

sin θ, so that the total force acting to tear the band apart is $\int_0^{\pi} mbtr^2\omega^2 \sin\theta d\theta = 2mbtr^2\omega^2$. But this force is resisted by two sections of the band, each of bt area. Therefore, the stress per unit area of the band due to centrifugal force is

$$f = mr^2\omega^2 \qquad (20)$$

Since $\omega = 2\pi n$ (where n is the number of rotations per second), in similar guns (having the same I. V. and final twist of rifling) ω is inversely proportional to the caliber; therefore $r\omega$ is the same for all calibers and so is the tensile stress on the band.

In applying (20), if r is expresed in feet, m is the mass of a cubic foot, and f is stress per square foot of area; whereas, if r is expressed in inches, m must be found by dividing the weight of a cubic inch of the material by the value of g in inches (32.2×12), and then f will be given as stress per square inch. For example, taking the case of a 12-inch gun with 2800 f. s. I. V. and a final twist of 1 turn in 25 calibres, we have $\omega = 2\pi \frac{2800}{25} = 224\pi$; and

the weight of copper being 560 pounds per cubic foot; $f = \frac{560}{32.2} \times (\frac{1}{2})^2 \times (224\pi)^2 = 2{,}153{,}000$ pounds per square foot = 14,950 pounds per square inch.*

A solid copper band will withstand this stress, but it is usual, for convenience in manufacture, to make the rotating bands of large projectiles in strips which are bent around the band score, forming what are called "split bands." These are kept from opening out and leaving the projectile under the influence of the centrifugal force by undercutting the edges of the band score and forcing the band into the undercuts by press or hammer. The intensity of the force tending to open these bands requires them to be put on with great care or they will be thrown off soon after the projectile leaves the gun.

THE ENERGY OF ROTATION.—If m is the mass and V the initial velocity, $E_x = \frac{mV^2}{2}$ is the energy of translation; and if ω is the angular velocity and ρ the radius of gyration (about the axis of rotation), $E_\rho = \frac{1}{2}m\rho^2\omega^2$ is the energy of rotation. But the linear velocity of rotation of the surface of the projectile is $V \tan \phi_2$, where ϕ_2 is the final pitch of the rifling, so that the angular velocity of rotation is $\frac{V \tan \phi_2}{a}$, where a is the radius of the projectile. Thus we have as the ratio of the two energies, of rotation and of translation:

$$\frac{E_\rho}{E_x} = \frac{\frac{m\rho^2}{2} \cdot \frac{V^2 \tan^2 \phi_2}{a^2}}{\frac{mV^2}{2}} = \frac{\rho^2}{a^2} \tan^2 \phi_2 \qquad (21)$$

Since $\frac{\rho^2}{a^2} = \frac{1}{2}$ approximately, and the value of $\tan \phi_2$ seldom exceeds $\frac{1}{3}$, the energy of rotation is less than 1% of that of translation.

THE POSITION OF THE ROTATING BAND.—Extensive experiments carried out under the direction of the Gavre Commission

*The reduction of section of the band where compressed by the lands of the rifling, the mean cross-section and total stress remaining unchanged, requires an increase of about $\frac{1}{4}$ in the stress per unit area as calculated above, so that we may take the stress upon the bands of the projectiles of modern high-power guns, due to centrifugal force, to be about 8 tons per square inch.

from 1876 to 1880 showed that with the French guns and projectiles then in use the position of the rotating band had a marked effect upon both range and accuracy of fire. The guns used were of 10, 14, 16 and 24 cm. caliber, and for each of them the distance from base of projectile to rear edge of band which gave the best results was found to be from 38 to 42 mm.* As a result of these experiments a distance from base of projectile to band of 1.5 inches has been adopted for all U. S. Naval projectiles (excepting for guns using fixed ammunition in which the insertion in the cartridge case governs the position of the band), and practically the same position of band is now almost universally used.

If a projectile has insufficient rotation when it leaves the gun, either because the final pitch of the rifling is too small or because the rotating band has slipped or stripped, the resistance of the air speedily gives it a wabbling motion, like that of a dying top, and the amplitude of this motion rapidly increases until, if the flight is long enough, the projectile tumbles end over end.†

But this motion of precession which we call "wabbling" often occurs even when the velocity of rotation imparted by the rifling is known to be sufficient, though in such cases the amplitude of the motion appears not to increase during the flight of the projectile and the latter does not "tumble." If the rotating band is of inadequate strength, so that, though it imparts the full velocity of rotation, it is nearly stripped in so doing, and especially when the wearing away of the lands of the rifling at its beginning, due to continued firing of the gun, has increased the tendency of the band to strip (on account of the diminished hold of the rifling on the band), wabbling, accompanied by loss of range and accuracy, is sure to occur. Under such circumstances the sound which

*An account of these experiments, translated from "Mémoires Militaires et Scientifiques," may be found in "Notes on the Construction of Ordnance No. 27," published by the Ordnance Department, U. S. A.

† If A is the moment of inertia of a projectile about its long axis and ω is the angular velocity of its rotation about that axis, the application of a force whose moment about a transverse axis through the center of gravity of the projectile is K will cause the projectile to turn about a second transverse axis (perpendicular to the first) through the center of gravity with an angular velocity $\omega_2 = \frac{K}{A\omega_1}$. Consequently, the smaller ω_1, the greater ω_2, and, with a given upsetting moment of the air resistance, the greater and the more rapidly increasing the angle of the cone of precession.

accompanies the projectile's flight ceases to be smooth and steady, and becomes harsh and undulating.

The wabbling motion just referred to is the result of the projectile's having an angular velocity about a transverse axis imparted to it in the gun,* and the remedy lies in having a profile of rotating band which will offer great resistance to such angular motion. The greater the width of the band, the less likely is wabbling to occur, and, since very wide bands cannot well be used with an increasing twist, this is another important element of superiority of rifling of uniform pitch over that of increasing pitch.

CONCLUSIONS.—From the foregoing, the writer draws the following conclusions:

(*a*) Uniform twist rifling is superior to variable twist in all important respects, and should be adopted in our future gun construction.

(*b*) With a depth of groove of 0.05″, four grooves to the inch of caliber is an insufficient number with the high muzzle velocities now common. We should increase the number of grooves in our guns to six to the inch of caliber.

(*c*) The width of the bearing surface of the rotating bands of our large projectiles (certainly the 12″ and 13″ and probably the 10″ as well) is insufficient, especially when the rifling is somewhat worn by firing.

(*d*) Increasing the diameter of the rotating bands will to some extent produce the same beneficial effects upon flight as increasing their width, but the former will accelerate the progressive wearing away of the rifling bands. The diameter of the bands should be no greater than necessary to prevent escape of gas past them; their material should be pure copper, thoroughly annealed; and, if practicable, their rubbing surface should be lubricated during their passage through the bore.

* In the writer's opinion the centrifugal force, due to the fact that the center of gravity of the projectile is not in the axis of rotation in the gun, acting during the interval between the exit of the bourrelet and the exit of the rotating band from the muzzle, gives the angular velocity about a transverse axis which results in wabbling.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

METHODS OF ESTIMATING THE COAL ENDURANCE OF A NAVAL VESSEL.

(Reprinted from the "Engineering News.")

By NAVAL CONSTRUCTOR D. W. TAYLOR, U. S. N.

The estimation of the radius of action of a naval vessel is a problem into which there enter so many varying factors that any solution must be an approximation at best, and hence open to question and criticism. The factors affecting the coal consumption of a vessel at a given speed may be enumerated as below:

1. The condition of the ship's bottom, whether clean or foul.
2. The wind and weather conditions.
3. The quality of the coal.
4. The condition of the machinery, main and auxiliary.
5. The skill and efficiency of the personnel.
6. The original design.
7. The amount of auxiliary machinery and steam appliances in use other than those required for propelling the ship.

Conditions may arise where any one of the first five factors above may be more powerful in influencing the radius of action than the factor of original design. The seventh factor is one which is exceptionally influential in the case of our men-of-war, which use much more steam for mechanical ventilation, heating, electric lighting, distilling fresh water, etc., than foreign vessels of war. This factor is the only one whose influence upon coal endurance may be readily magnified or decreased at will. While under ordinary circumstances, as stated above, it is generally larger for our men-of-war than for foreign vessels, it should not be forgotten that it can be readily reduced in an emergency.

The five factors first enumerated above are subject to erratic variations. Hence we must expect to find the coal consumption

of a given ship in service varying erratically. Conversely any method of estimating coal consumption will give results seriously discordant with what will at times be experienced in practice.

From one point of view it would seem most logical and scientific to estimate the radius of action of naval vessels under the most favorable circumstances, that is, with clean bottom in calm weather and smooth water, using the best coal, with all machinery in the best condition, with the best skill used in working machinery and with no machinery in use except that needed for propelling and handling ship. Under these circumstances the factor of original design would be no longer masked and the skill as regards coal endurance of the designer of the machinery would be duly appreciated or discredited.

It is the universal practice to try a ship for speed under the most favorable circumstances and accept the fact that the maximum speed to be expected in service will fall short of the maximum trial speed by a varying amount. The matter of coal consumption is, however, on a somewhat different basis. In actual service men-of-war are seldom pushed to the utmost, and the fact that on the rare occasions when they are so pushed their speed will fall somewhat short of what was attained on trial is a matter of rather remote bearing on the everyday conduct of the ship or fleet. When it comes to burning coal, however, we are dealing with a matter of everyday experience. It may be of interest to the people on the ship to know what the coal consumption would be in case an almost impossible combination of circumstances should supervene, but for practical purposes it is a necessity that they should know with reasonable certainty the actual coal consumption under given circumstances. Each ship in service is constantly acquiring experience on this subject, and, after a reasonable accumulation of such experience, the people on board know sufficiently well what may be expected from her. Now, shall the designer estimate the endurance under absolutely the most favorable circumstances, or shall he aim at the determination of the endurance that may be expected to be averaged in practice? It seems obvious to me that the latter course has the balance of advantages in its favor. One paramount advantage is due to the fact that in estimating actual endurance the results of everyday experience are available as a basis. The Bureau of Steam Engineering has a large accumulation of such results, and the average consumption results for a number of our

ships, based on the records of the Steam Engineering Bureau, have recently been published.

Having settled the broad lines upon which to work, I will take up next a few basic considerations.

If for a given ship we know the indicated horse power which must be developed to maintain a given speed and the coal which must be consumed per hour for each indicated horse power, the consumption at that speed is known. The engines of naval vessels burn more coal per I. H. P. as the I. H. P. is reduced. As the variation from ship to ship is not so very great, a reasonable method of approaching the question of variation of consumption per I. H. P. would seem to be to plot the coal per I. H. P. as ordinates over fractions of the maximum I. H. P. of the engine as abscissæ, the maximum I. H. P. developed by the engine being taken as unity in each case. It would be slightly more correct theoretically instead of using the fractions of maximum I. H. P. to use the mean effective pressure, but for present purposes this does not seem necessary.

The only large ships in our service for which we have accurate I. H. P. curves and coal consumption data are the Alabama, Massachusetts and Kearsarge. Fig. 1 shows for these ships curves of pounds of coal per I. H. P. per hour plotted over fractions of the maximum trial I. H. P. The I. H. P. used is that of the main engines only, while the coal consumed is that for all purposes. The curves of coal consumption of Fig. 1 should not be compared with curves of coal consumption as generally given without fully realizing that they show total consumption per I. H. P. of main engines only, and are the average of numerous results in service obtained with various conditions of bottom, various displacements and various qualities of coal. Hence they are necessarily materially higher than would be shown in any coal consumption trial.

The curves of Fig. 1 are seen to be essentially similar in nature, as is to be expected, and it seems reasonable to consider that their average will be fairly representative of our battleships. When using this average curve for a ship not yet tried,

Name.	Bunker Capacities. Tons.	Name.	Bunker Capacities. Tons.
Connecticut	2,200	Alabama	1,270
Virginia	1,704	Massachusetts	1,560
Idaho	1,750	Tennessee	2,000
Maine	1,800	St. Louis	1,500
Kearsarge	1,550	Olympia	1,170

it is necessary to have an I. H. P. curve for the latter. I have estimated the I. H. P. curves for a number of classes of our ships and thus prepared Fig. 2, which shows the endurances of the ships in question, estimated by the method outlined above. The assumed bunker capacity, upon which endurance is based, is indicated in each case. In the case of the Maine, an actual curve of I. H. P. was available, but she has not yet been long enough in commission to supply a reliable average coal consumption curve, so in her case the actual curve of I. H. P. was used instead of an estimated one.

The above method will undoubtedly give results reasonably near the average for ships of the same general type and with machinery reasonably similar to that of the ships used in obtaining the average coal consumption curve. It has the objection for design purposes of requiring the I. H. P. curve to be estimated, while we frequently want to estimate the endurance of a design before the I. H. P. curve or maximum speed and power are settled.

It appears desirable, then, to develop some other method of approximating to endurance. Now, for naval vessels the endurance at about 10 knots is reasonably close to the maximum endurance in any case. At such speeds the resistance of these vessels is nearly all frictional and proportional to the wetted surface. The wetted surface is closely proportional to the square root of the displacement multiplied by the length. Let D denote displacement in tons and L the water line length in feet. If then the resistance at 10 knots varies as the wetted surface, it varies as $\sqrt{DL}$, and the effective power is proportional to the same quantity. If then the coal consumption at a given moderate speed is proportional to the effective power it will be proportional to the wetted surface, or to $\sqrt{DL}$. Let m denote the miles made per ton of coal consumed, and C the coal consumed per day in tons. Let k denote a coal consumption coefficient. Then $C = k\sqrt{DL}$. If V denotes the speed in knots, then $m = \frac{24\ V}{C} = \frac{24\ V}{k\sqrt{DL}}$. Both m and k are readily calculated if a curve of coal consumption per day in tons plotted over speed is available.

Let us write $k_0 = \frac{24\ V}{k} = \frac{24\ V\sqrt{DL}}{C} = m\sqrt{DL}$. Then $m = \frac{k_0}{\sqrt{LD}}$. Now, the coal coefficient, k_0, should be semi-constant,

i. e., it should not vary much on a given ship throughout the range of moderate speeds and should not vary much in passing from ship to ship. If at the moderate speeds to which the above method is applicable the whole resistance were that due to friction of the wetted surface only, and if all ships had at these moderate speeds the same coal consumption per I. H. P., and the same efficiency of propulsion, then one curve of k_o would apply to all ships.

We know that the above suppositions are not correct. The only method of determining whether they are sufficiently close approximations to the facts to be of practical value is by investigation of actual results. Fig. 3 shows the curves of k_o for a number of naval vessels as obtained from their average curves of coal consumption under all conditions. Using the average curve of k_o shown in Fig. 3, we obtain the estimated endurance for a number of naval vessels which are plotted in Fig. 4. The assumed bunker capacities for Fig. 4 are the same as used in obtaining Fig. 2. Fig. 4 should be compared with Fig. 2, which shows the estimated endurances of the same vessels obtained by the method first described.

It is seen that the results of Fig. 4 and Fig. 2 differ a good deal in some cases, but when we see in Fig. 3 the wide difference of endurance between the Massachusetts and her sister ship, the Oregon, the endurances in question being the average results of a number of years' experience under all sorts of conditions, it is evident that we cannot expect any formula to give a very close approximation in practice, since any possible formula or approximate method to be applied before the ships were built would necessarily give the Massachusetts and the Oregon the same endurance. Some of the discrepancies between Figs. 4 and 2 are, however, susceptible of qualitative explanation. Generally speaking, it is seen that in Fig. 2 the endurances of the vessels of moderate power are much greater than in Fig. 4, while those of the higher-power vessels are less. The methods used in obtaining Fig. 4 take no account of the amount of power originally installed, and as the average curve of k_o obtained in Fig. 3 is the result of experience with moderate-powered vessels rather than high-powered vessels, it is very evident that in Fig. 4 the endurances of the high-powered vessels are overestimated.

Suppose we have two similar vessels, A and B, which require

1500 effective horse power to drive them at 10 knots, and suppose, moreover, that in vessel A the maximum power of the engines is 20,000, while in vessel B it is only 5000. Suppose that the machinery in each case is of the same general type. Evidently, then, vessel B at 10 knots will waste very much less power in friction of machinery than vessel A, which has machinery capable of developing four times the power of B. Hence, the indicated horse power required to drive vessel B at 10 knots will be less than that required to drive vessel A. Moreover, vessel B will be working at a fairly large fraction of her maximum power, and hence her engines will be working under economical conditions, requiring nearly their minimum of coal per I. H. P. per hour. Vessel A, however, will be working at a very small fraction of her maximum power, and not only will she require more indicated horse power than vessel B, but each horse power per hour will require much more coal. Hence, the coal consumption of A must be materially greater than that of B.

The methods used to produce Fig. 2 take some account of these conditions, while those used for Fig. 4 ignored them and would give vessels A and B the same endurance at 10 knots, regardless of the maximum capacity of their engines. Thus, the methods used for producing Fig. 2 are essentially more accurate than those used to obtain Fig. 4. I do not consider, however, that they are of much more value in practice. They require more data, and if we follow the wetted surface method, and, instead of always using the same coal coefficient, k_o, choose a coefficient with discretion to suit the type of ship, we ought to obtain satisfactory results.

It may be of interest to supplement Fig. 3 with some data regarding 10-knot merchant ships. The wetted surface method should be applied with some caution to them, because, being designed for moderate speed only, their residuary resistance other than that due to skin friction generally forms a larger proportion of the whole than for men-of-war at moderate speeds. Taking the consumption used for propelling the ship only, a large 10-knot freighter with some passenger accommodation gave the results below upon four consecutive Atlantic passages. It happened that two of these were when loaded to a displacement of

about 18,000 tons, and two were when light at a displacement of about 9000 tons:

Passage No. 1, loaded, $k_o = 11{,}060$.
" " 2, light, $k_o = 12{,}010$.
" " 3, loaded, $k_o = 12{,}630$.
" " 4, light, $k_o = 8{,}830$.

The first three passages were made under moderate weather conditions, although rather more stormy than ordinary fair weather at sea. The last passage was made in exceptionally heavy weather throughout, gales blowing almost without intermission, and it is seen that there is a big reduction in the endurance.

Another instance is that of the naval collier Lebanon, at about 3100 tons displacement, which during the run from Baltimore to Colon, 2000 miles, at a 9-knot speed, showed an average value of k_o of 12,450.

The large collier Ajax, of about 9000 tons displacement, during a run of 11,700 miles, from Hampton Roads to Manila, at about 10 knots speed, showed an average value of k_o of 12,900. The Lebanon and Ajax trips were both fair weather trips.

Fig. 5 shows a curve of k_o for one of our destroyers when tried especially for endurance. It shows also an average curve of k_o for five destroyers as deduced during the first portion of the run of the flotilla of five to Manila. The wide difference between the curves is characteristic of the difference between special trials and average service results, although it is possible that it is partly due to superior design in the case of the single destroyer. Even for these destroyers it is seen that the most economical speed does not rise above 10 knots. There is a natural tendency for the economical speed to be higher for high-powered vessels than for low-powered vessels. This is because the relative waste by friction of machinery is less as we increase speed and power. The less the friction of the machinery, however, the lower the economical speed, and the fact that this does not exceed 10 knots for any of our vessels for which we have reliable coal consumption data is indirect evidence of the smooth running qualities of their machinery.

What I have said hitherto applies entirely to United States vessels. Anyone familiar with the coal endurances ascribed to foreign men-of-war will have noticed that the actual and esti-

mated endurances of our ships are decidedly below those frequently credited to foreign vessels. For instance, *Le Yacht*, of Sept. 12, 1903, in describing the new Russian battleship Czarevitch, says:

> Radius of action: At normal load the ship can carry 800 tons of coal, but the total capacity of bunkers will permit her to take about 1350 tons, which will give her a radius of action of 5500 miles at 10 knots. This theoretical radius of action will find itself sensibly increased in practice by reason of the very small consumption of coal, which on trials was only 1.33 lbs. at 12 knots, with 3640 H. P., and 1.72 lbs. at more than 18 knots, with 15,800 H. P.

The Czarevitch is 389 ft. long, of 26 ft. draft, 76.1 ft. beam, and of 12,960 (English) tons displacement. It is seen that she is not very different from the Maine, and the Maine on 1800 tons of coal has a maximum average endurance of 5220 miles, while to the Czarevitch we find ascribed 5500 miles on 1360 tons. The value of k_0 for the Czarevitch at 12 knots is 9150, while that for the Maine at the same speed is 6452. It is to be remarked in addition that it requires 3,640 I. H. P. to drive the Czarevitch at 12 knots, while the Maine makes this speed for less than 3000 I. H. P. In other words, the Czarevitch at 12 knots, with more than 20 per cent more horse power than the Maine, claims an endurance per ton some 40 per cent greater than that of the Maine. It should be pointed out, however, that the estimated endurance of the Czarevitch is based upon trials under the most favorable conditions.

Another instance is that of the Chilian battleship Libertad, built by the Vickers-Maxim Co., now the English Triumph. London *Engineering* of Dec. 11, 1903, in describing this vessel, made the following statement:

> The next fighting quality of interest is that of coal capacity, and the trials afforded interesting data on this question. The Libertad can take 2000 tons, and it was found that steaming at 12 knots necessitated a consumption of about 1¾ tons per hour; at 15 knots, 3½ tons per hour; at 17¼ knots, about 6¼ tons per hour; and at 20 knots, about 11 tons—all of them satisfactory results for a battleship with such fighting qualities. This consumption, of course, includes that required for all purposes. It will thus be seen that the vessel could steam for 8600 miles easily at a speed of about 15 knots, which, for most purposes, is quite sufficient;

And again in its number of Jan. 15, 1904, *Engineering* gives the curve of coal endurance, showing an endurance at 10 knots of

12,000 miles. This would make the value of k_0 for the Libertad 18,510 at 10 knots and 15,580 at 12 knots.

The endurances of the foreign ships quoted above were estimated from the results of short trials made under the most favorable conditions. The endurances of our ships shown by Fig. 3 are the averages of actual experience under all sorts of conditions. Our ships under the most favorable conditions would materially exceed the endurance of Fig. 3, but then again, under the most unfavorable conditions, are liable to fall short of them. After making all allowances, however, the differences between the results of our experience and some results credited to foreign ships are so great as to render it evident that the latter are inaccurate or that coal economy needs to be looked after much more sharply in our service than has been the case hitherto.

In this connection attention may be called to some results recently obtained in service on English vessels. Two Belleville boilered ships, the Spartiate and the Europa, were sent to China at economical speeds, the distance steamed being about 9600 miles. These are sister ships as regards dimensions, which are as follows: Length, 435 ft.; beam, 69 ft.; mean draught, 27.5 ft.; displacement, 11,000 tons. Some time before the same voyage was made by the protected cruiser Blenheim (Scotch boilers), whose dimensions are as follows: Length, 375 ft.; beam, 65 ft.; mean draught, 27.5 ft.; displacement, 9000 tons. Sir William White has stated regarding the trip of these vessels:

> On the voyage out the Spartiate averaged 12.65 knots, steaming easily and developing less than 20 per cent of her full power. Her average coal consumption for all purposes was 2.29 lbs. per indicated horse power per hour. The Europa was sent out at a still lower power—about 13 per cent of the maximum, the average speed being 10¾ knots. Her consumption was therefore higher, namely, 3.85 lbs. per horse power hour, and she burnt on the passage nearly 700 tons more than the Spartiate. This demonstrated the fact, previously well understood, that for covering distance the higher speed was more economical in a ship of the type with great engine power. But the most interesting fact remains to be stated: The Spartiate burnt nearly 1200 tons less on the voyage than the Blenheim did on the same voyage, the latter being 2000 tons smaller in displacement, and having cylindrical boilers. The Europa burnt nearly 500 tons less.

The actual coal consumptions for the 9600 miles were very approximately as follows: Spartiate, 3000 tons; Europa, 13,700 tons, and Blenheim, 4200 tons. In the case of the Blenheim this experience sheds some light on actual endurance as contrasted

with paper endurance. Jane's "All the World's Fighting Ships" credits the Blake and Blenheim with an endurance of about 9000 miles on 1800 tons at 10 knots. As a matter of fact, on the voyage to China, which was made at low speed, the Blenheim showed an endurance of 9600 miles on 4200 tons, or only 46 per cent of the paper endurance with which she is credited. Of course, this is a single voyage and the Blenheim might show better results at other times. In order to compare the actual results of these three ships with our experience, I have spotted on Fig. 3 the values of k_o for the Spartiate, Europa and Blenheim on the voyage to China. The exact speed of the Bleheim not being known, I put it down at 10 knots. After making allowance for the fact that the Spartiate and Europa trips were made with a special view toward economy of coal, I think it will be conceded that if the Spartiate, Europa and Blenheim experience is fairly representative of English vessels, the ordinary average results of our vessels in practice compare very favorably with them.

It is the practice in the English service to determine coal consumption of new vessels at maximum power with forced draught at about two-thirds maximum power and at about one-fifth maximum power.

Engineering of Jan. 1, 1904, published a number of results for the most recent English ships tried during 1903. These I have tabulated in the table herewith, and in Fig. 6 I have plotted these results over fractions of the maximum I. H. P. obtained in each case. I have also shown by a dotted curve the average consumption of Fig. 1, obtained from our battleship experience, and shown the spots giving the consumption of the Spartiate and the Europa on their voyage to China. There was no information as to a similar spot for the Blenheim, but it would undoubtedly have been well above the spot for the Europa.

The dotted curve of Fig. 6 represents the average of our experience with three battleships, under all sorts of conditions, with all sorts of coal, and when using large amounts of coal for distilling, lighting, heating and mechanical ventilation. It is not likely that during the coal consumption trials of the English vessels, when, of course the best quality of coal was used, there was any appreciable expenditure of it for distilling, heating or mechanical ventilation, and, after giving due consideration to the essentially different circumstances, I think it will be admitted

COAL CONSUMPTION OF ENGLISH NAVAL VESSELS, TESTED IN 1902.

Name of Ship.	Type of Ship.	Length, Ft.	Displacement, Tons.	60 hour trial.—65% Power. I. H. P.	60 hour trial.—65% Power. Coal consumption, lbs.	60 hour trial.—70% Power. I. H. P.	60 hour trial.—70% Power. Coal consumption, lbs.	Full power.—I. H. P.	Full power.—Coal consumption, lbs.
Duncan	Battleship	405	14,000	3,755	2.05	13,717	1.90	18,232	1.95
Russell	"	"	"	3,767	2.4	13,695	2.14	18,190	2.10
Montagu	"	"	"	3,676	2.21	13,653	1.78	18,113	2.22
Exmouth	"	"	"	3,667	2.18	13,774	1.95	18,285	2.117
Cornwallis	"	"	"	3,734	1.96	13,697	2.09	18,301	1.89
Albemarle	"	"	"	3,606	2.26	13,576	2.11	18,301	1.96
Average of Duncan Class				3,699	2.18	13,682	2.00	18,220	2.04
Queen	Battleship	400	15,000	3,058	1.84	11,670	1.61	15,556	1.76
Pr. of Wales	"	"	"	3,128	2.21	11,669	2.08	15,364	2.02
Monmouth	1st Cl. Cruiser	440	9,800	4,711	1.83	16,326	1.45	22,189	1.97
Essex	"	"	"	4,643	2.03	16,133	2.17	22,219	2.22
Lancaster	"	"	"	4,643	2.1	16,044	2.16	22,881	1.94
Suffolk	"	"	"	4,954	1.89	16,350	1.89	22,645	2.2
Euryalus	"	"	"	4,780	1.99	16,510	2.22	21,302	1.98
Clio	Sloop	185	1,070	311	2.32	1,041	1.94	1,435	2.03
Challenger	2d Cl. Cruiser	355	5,880	2,636	1.745	8,972	1.74	12,781	1.78

that the coal consumption of our earlier battleships does not compare unfavorably with that of the English vessels which were given coal consumption trials during 1903.

Valuable data on coal consumption of modern war vessels are contained in a paper read about a year ago before the Japanese Society of Naval Architects etc., by the Engineer-in-Chief of the Japanese Navy. This paper gave the coal consumption of a number of Japanese warships (built in England, France and the United States) on their voyages from the country where built to Japan. These voyages were made at low speeds and were from ten to twelve thousand miles long except in the case of the Chitose built in San Francisco. In Fig. 7 I show a comparison between this Japanese experience, our experience, and the English Spartiate, Europa and Blenheim experience. It is seen that, broadly speaking, the results from the three nations show remarkably close agreement. The best results, the worst results, and the average results of the several nations are in substantial agreement.

JAPANESE SHIPS.

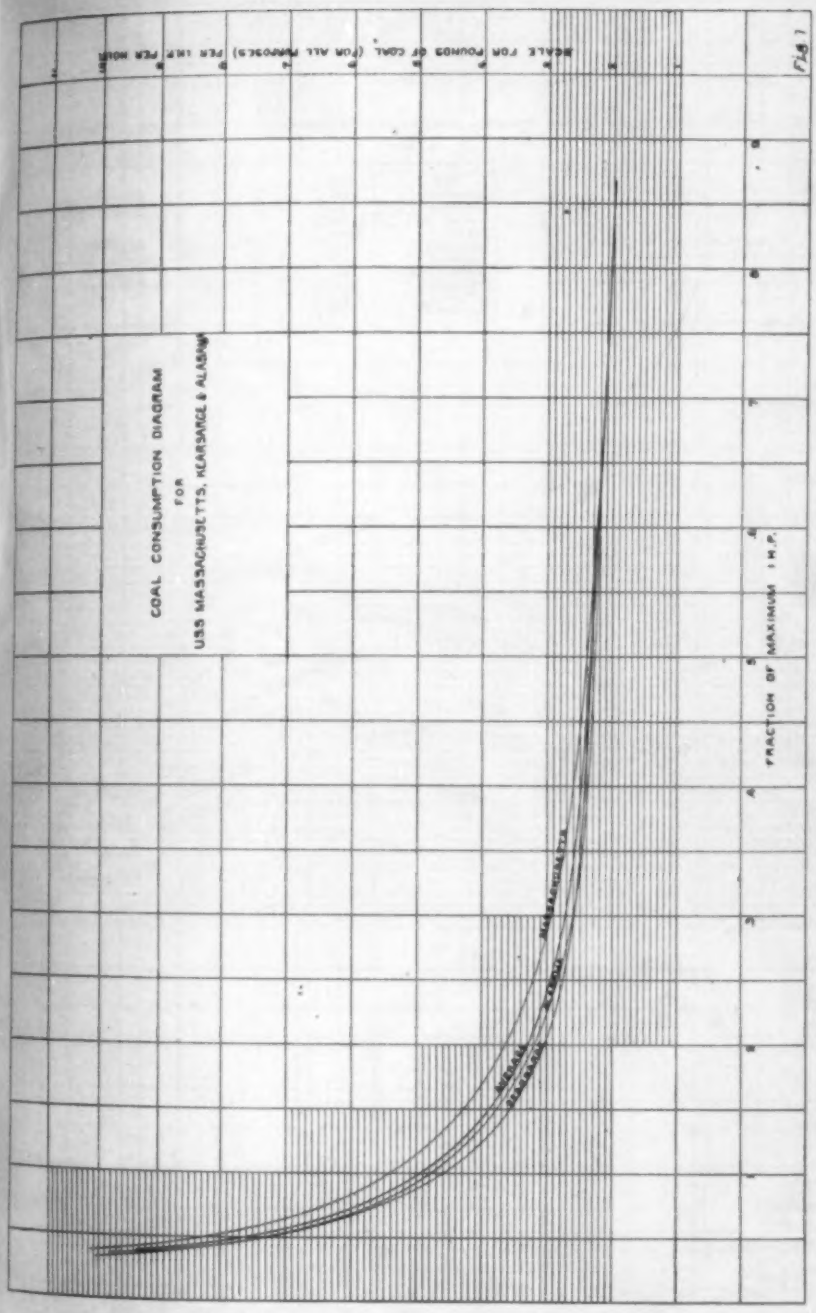
No.	Name.	Type.	Date of Launch.	Length, P.P.S., Ft.	Displacement, Tons.
1.	Shikishima	B.S.	1898	409	14,850
2.	Asahi	B.S.	1899	400	15,200
3.	Mikasa	B.S.	1900	400	15,139
4.	Yakumo	A.C.	1899	409	9,846
5.	Azuma	A.C.	1899	446	9,307
6.	Iwate	A.C.	1899	400	9,750
7.	Idzumo	A.C.	1900	400	9,750
8.	Fuji	B.S.	1896	374	12,450
9.	Yashima	B.S.	1896	374	12,450
10.	Asama	A.C.	1898	408	9,700
11.	Tokiwa	A.C.	1898	408	9,700
12.	Takasagi	C.	1897	360	4,160
13.	Kasagi	C.	1897	275	4,900
14.	Chitose	C.	1898	377	4,760

COAL FACTOR.

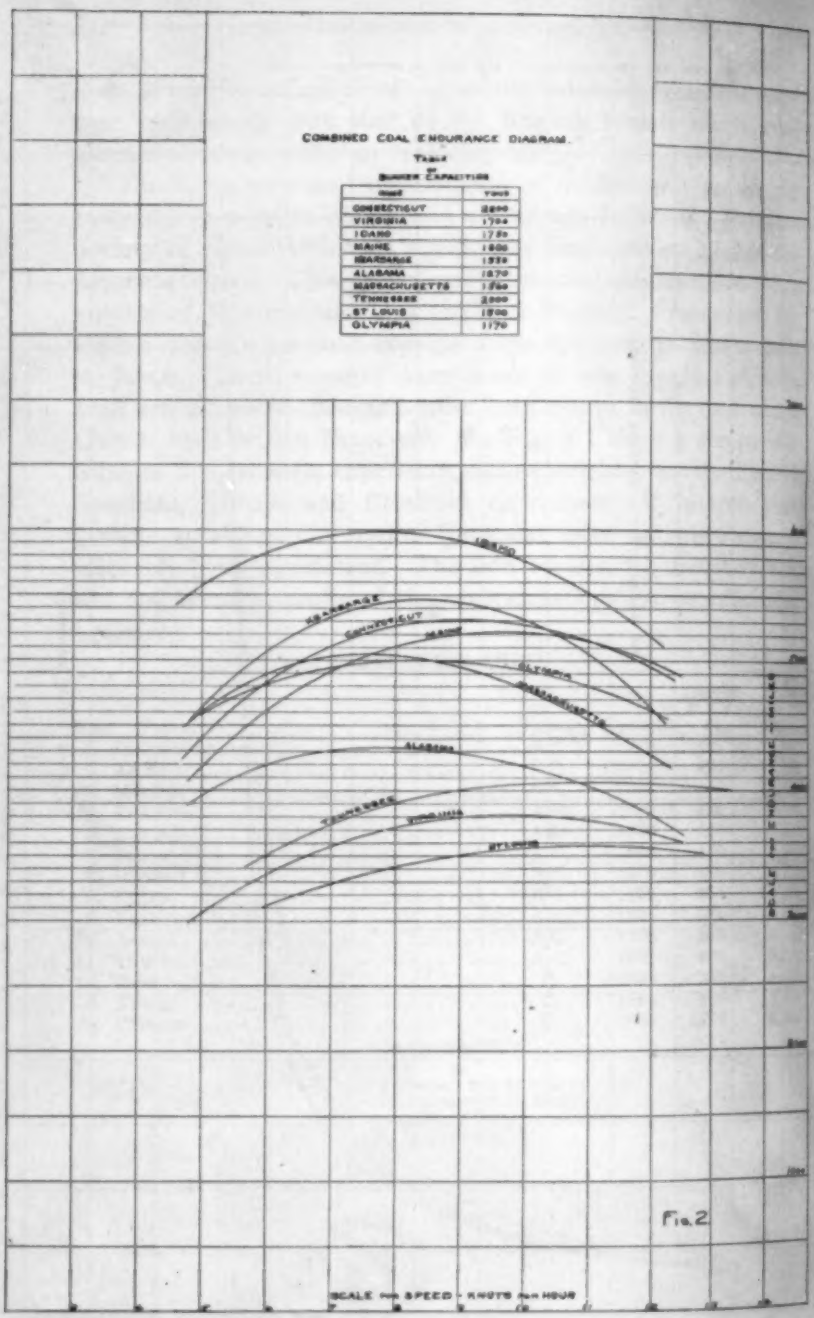
k_c

m = miles per ton of coal;
D = displacement, in tons;
L = length, in feet.

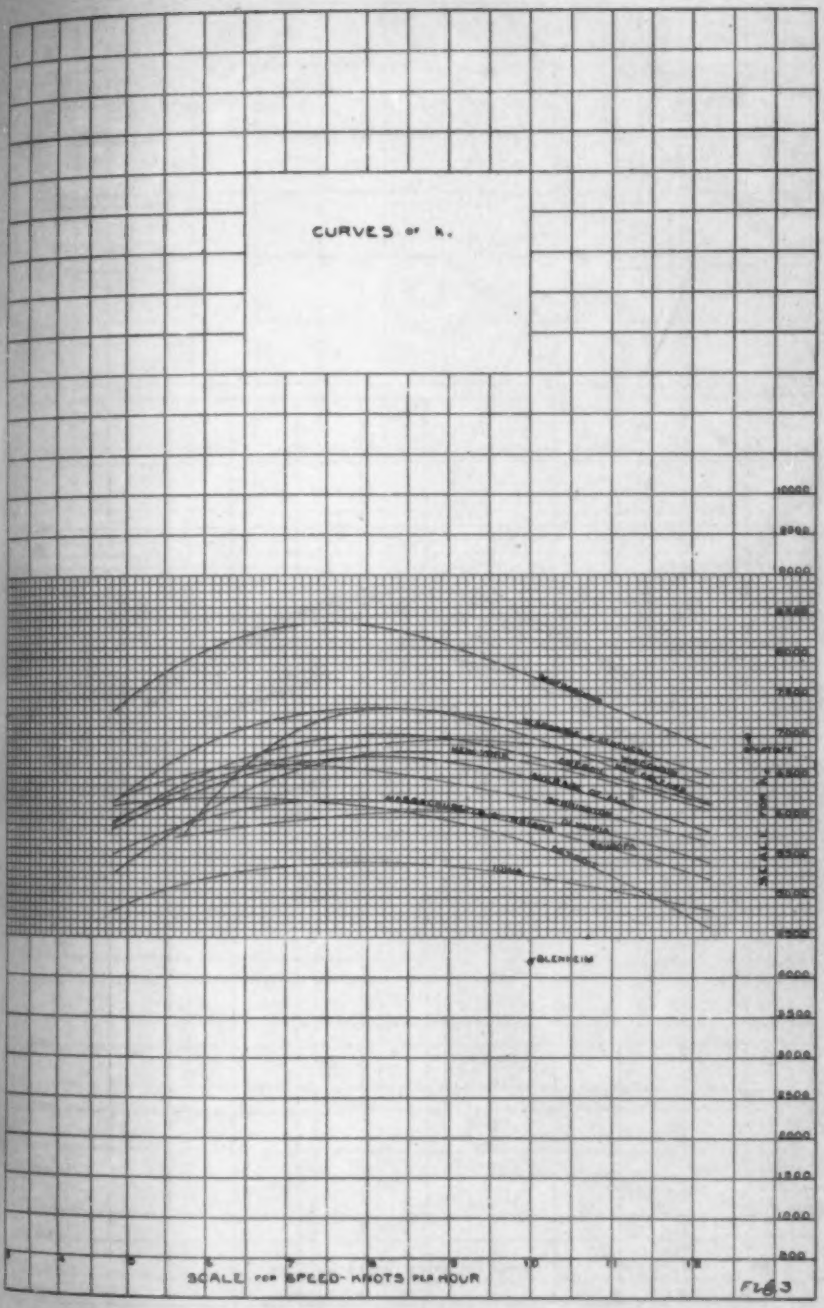
$$k_c = m\sqrt{DL}.$$



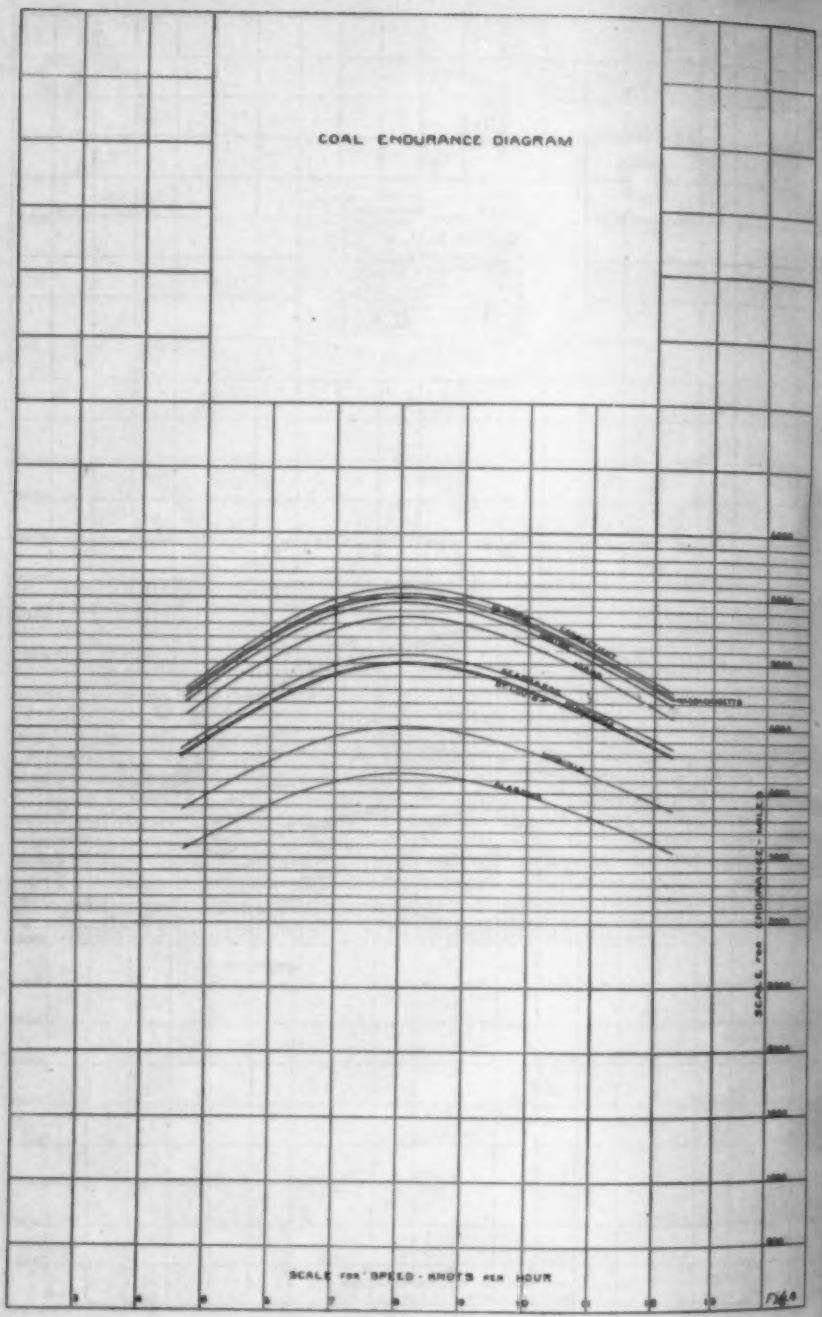
COAL CONSUMPTION OF U. S. BATTLESHIPS MASSACHUSETTS, KEARSARGE AND ALABAMA.



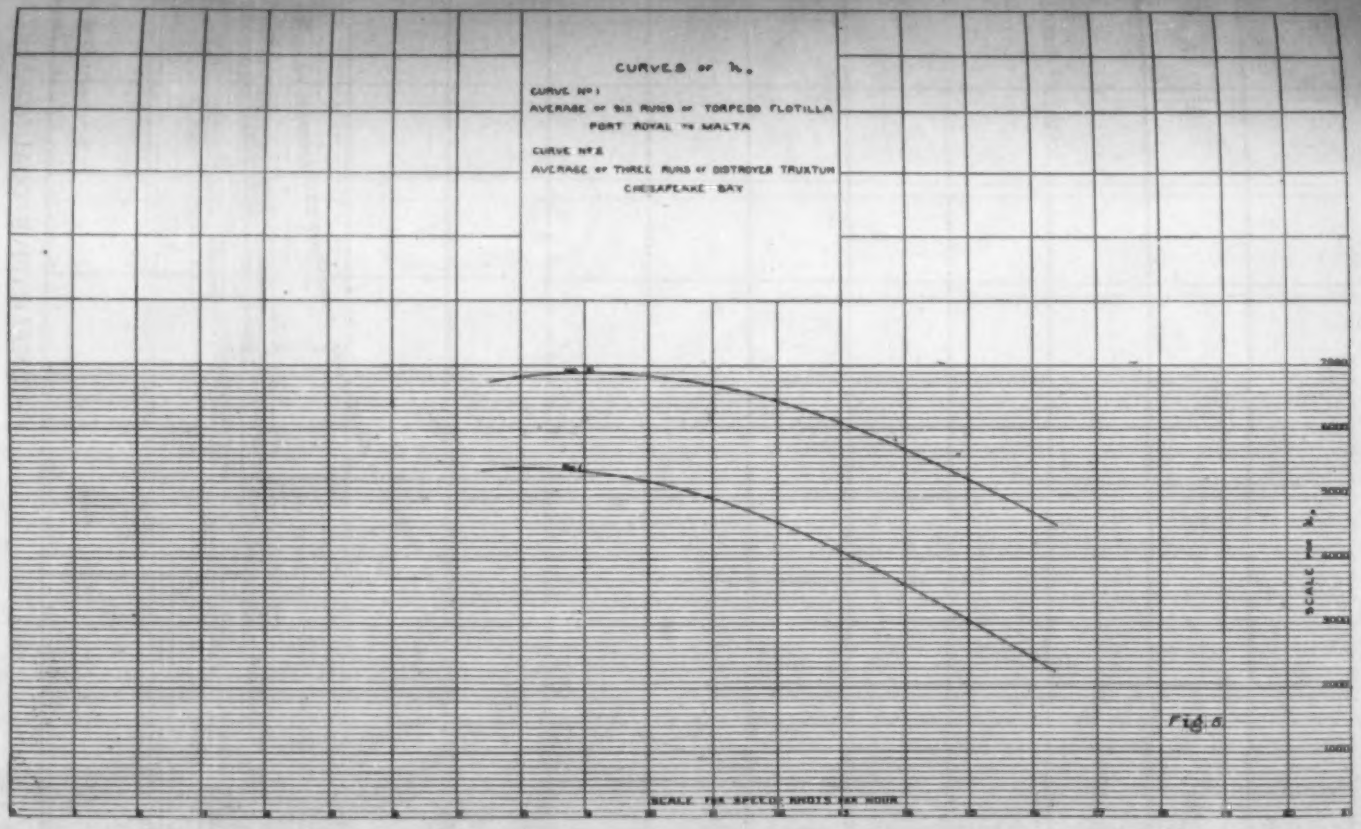
COAL ENDURANCE DIAGRAM OF VARIOUS U. S. NAVAL VESSELS PLOTTED FROM ESTIMATED I. H. P.



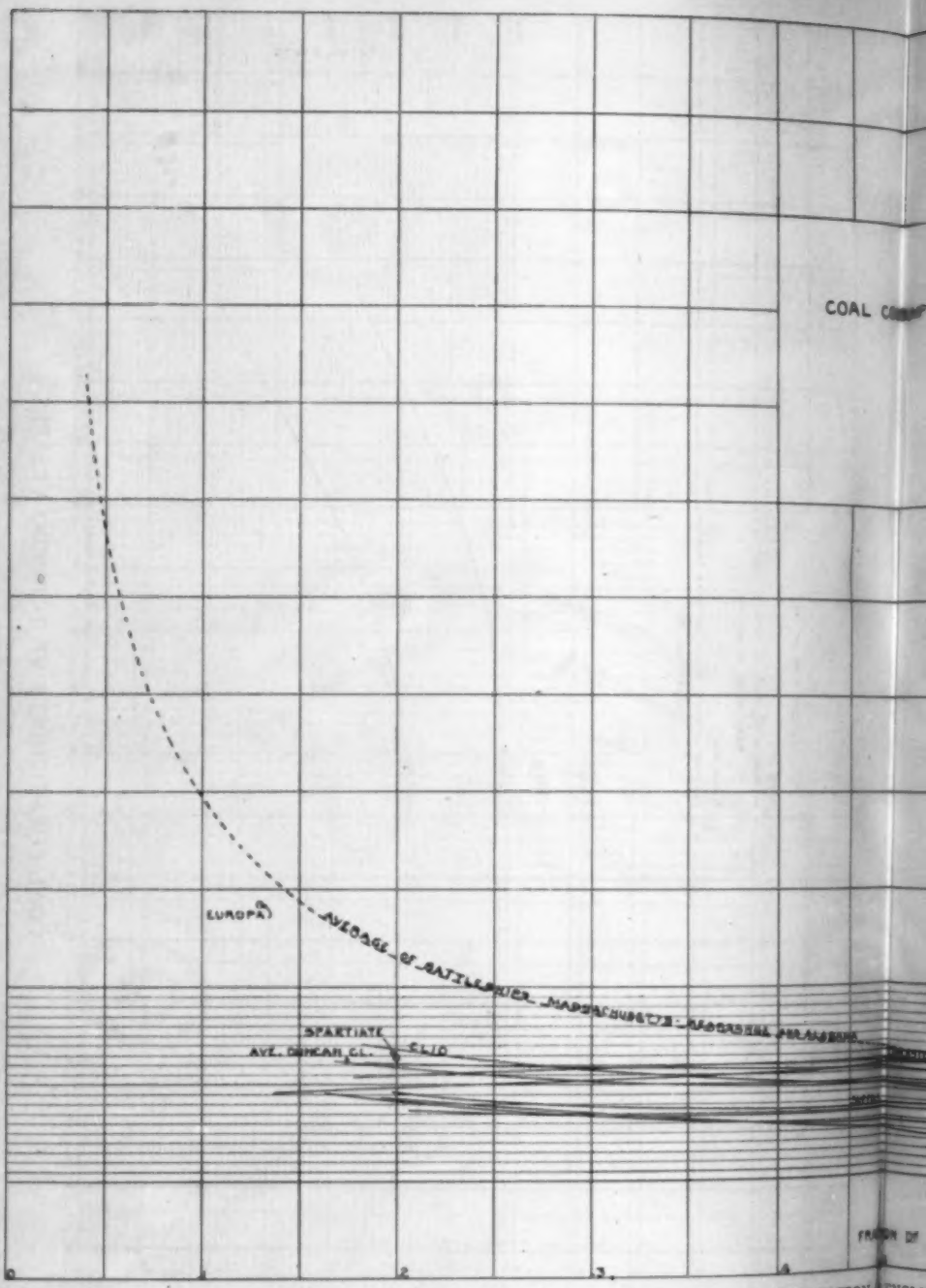
COAL COEFFICIENTS FOR VARIOUS VESSELS.



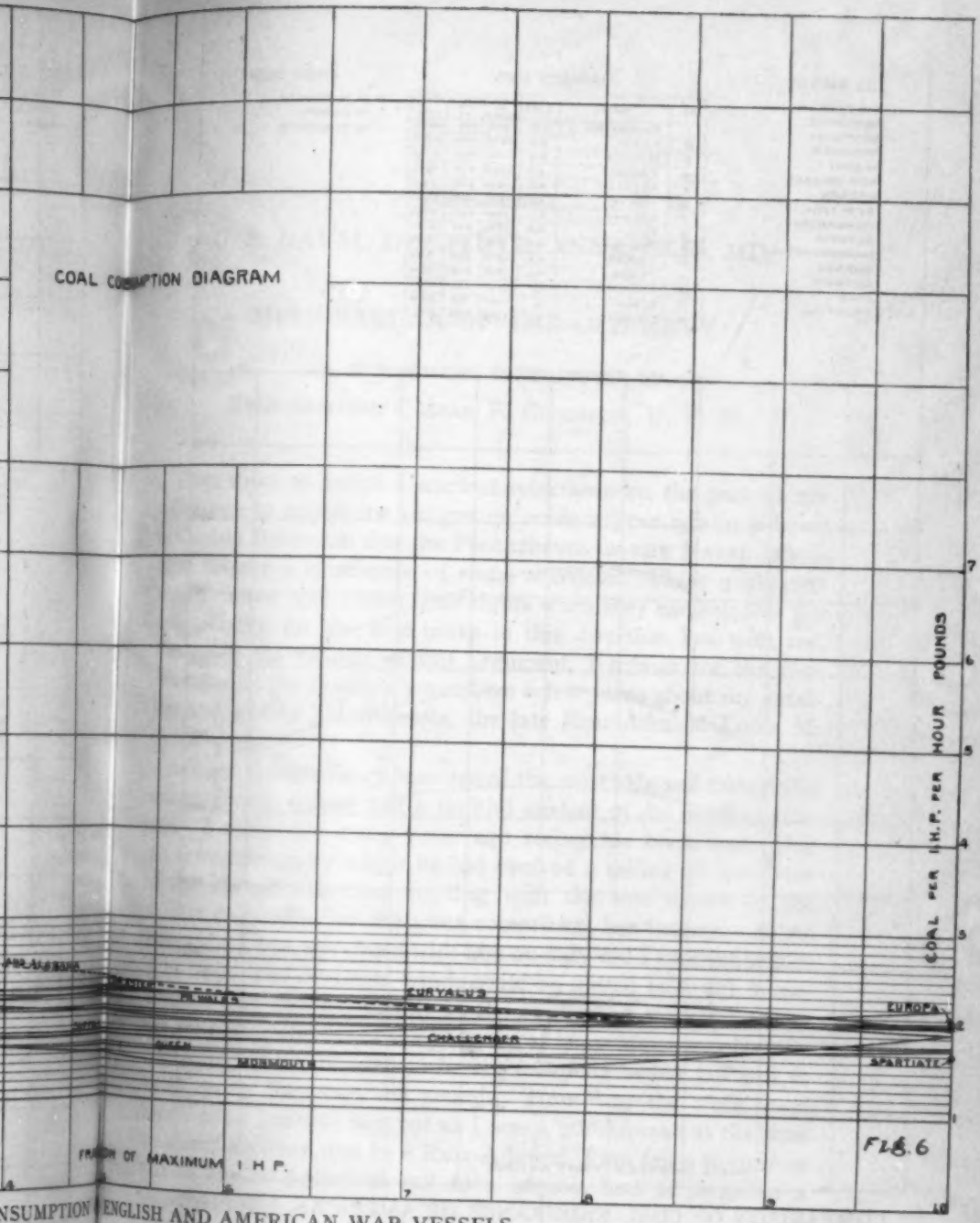
COAL ENDURANCE DIAGRAMS PLOTTED FROM ESTIMATED WETTED SURFACE.


CURVES OF k.
CURVE No 1
AVERAGE OF SIX RUNS OF TORPEDO FLOTILLA
PORT ROYAL TO MALTA
CURVE No 2
AVERAGE OF THREE RUNS OF DISTROYER TRUXTUN
CHESAPEAKE BAY
SCALE OF k.
SCALE FOR SPEED IN KNOTS PER HOUR
Fig. 6

COAL COEFFICIENTS OF TORPEDO VESSELS.



COMPARATIVE COAL CONSUMPTION ENGLI



NSUMPTION ENGLISH AND AMERICAN WAR VESSELS.

US WARSHIPS

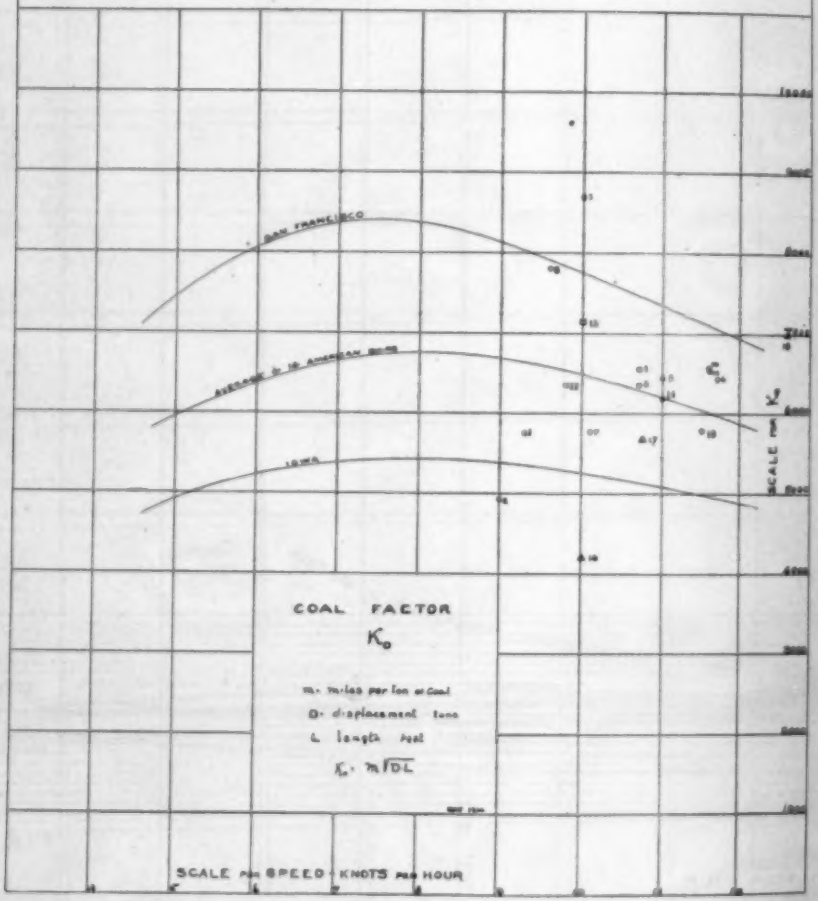
SAN FRANCISCO
KEARSARGE
KENTUCKY
WISCONSIN
ALBANY
NEW ORLEANS
OREGON
NEW YORK
BENNINGTON
OLYMPIA
MASSACHUSETTS
INDIANA
DETROIT
IOWA
No 15 TRUXTUN

JAPANESE SHIPS

No	NAME	TYPE	DATE OF LAUNCH	LENGTH BPD FT	DISPLT TONS
1	SHIKISHIMA	B.S	1898	400	14850
2	ASAHI	B.S	1899	400	15200
3	MIKASA	B.S	1900	400	15180
4	YAKUMO	A.C	1899	409	9646
5	AZUMA	A.C.	1899	446	9307
6	IWATE	A.C.	1899	400	9750
7	IDZUMO	A.C.	1900	400	9750
8	FUJI	B.S.	1896	374	12450
9	YASHIMA	B.S.	1896	374	12450
10	ASAMA	A.C.	1898	400	9700
11	TOKIWA	A.C.	1898	400	9700
12	TAKASAGI	C	1897	360	4180
13	KASAGI	C	1897	375	4900
14	CHITOSE	C	1898	377	4760

OTHER SHIPS

No 16 BLENHEIM.
17 EUROPA
18 SPARTIATE



COAL FACTOR

K_o

m = miles per ton of Coal
D = displacement tons
L = length feet

$K_o = m\sqrt{DL}$

COMPARISON OF COAL ENDURANCE OF AMERICAN, ENGLISH AND JAPANESE NAVAL VESSELS.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MEMORABILIA OF THE OLD NAVY.

AN INSTALMENT CONTRIBUTED BY

REAR-ADMIRAL CASPAR F. GOODRICH, U. S. N.

I am sorry to notice a marked reluctance on the part of my colleagues to accept the suggestion made a year ago in a letter to Captain Brownson that the PROCEEDINGS OF THE NAVAL INSTITUTE become a storehouse of naval anecdote. These gentlemen are, of course, well within their rights when they exclaim that the responsibility for the first move in this direction lies with me. Conceding the validity of this argument, I submit for the consideration of the Institute's members a few yarns about my excellent and worthy old shipmate, the late Rear-Admiral Louis M. Goldsborough.

Admiral Goldsborough was one of the most able and thoughtful of our officers, a close and a faithful student of the naval profession. I remember many years ago seeing his book containing the computations by which he had evolved a sailing sloop-of-war of the Portsmouth class starting with the sole datum of the number and caliber of the guns comprising her battery. At no time while I was associated with him on duty did I ever know him to be idle. The moments which could be spared from his immediate duty he devoted mainly to the reading of technical works and to keeping abreast of the progress of his profession. He was a very large man, reputed to be six feet four inches tall and to weigh nearly four hundred pounds. How near the truth these figures come I cannot say, but as I was a midshipman at the time we served together, and he a Rear-Admiral, I am feign to confess that to me he looked as tall as a sequoia and as large as a mountain.

My first remembrance of Admiral Goldsborough was in 1864

(I think) when he came to the Naval Academy as a member of the Board of Visitors that year. His size, his rank, his uniform, his dignity, all tended to make a deep impression on my youthful mind. I can see him even now as he rolled up toward the mess table in the dining room of the old Atlantic House at Newport, Rhode Island, where I sat, with Downes Wilson, the smallest kid in the Academy, on my right. Downes' feet were tucked up on the highest rung of his chair and he was plying a very excellent knife and fork, making great havoc with the ration which lay on the plate before him. The smallness of this midshipman, the largeness of his portion of food, the brilliancy of his knife and fork play could not fail to attract the attention of so keen an observer as was old Goldsborough, who paused and, addressing Downes in a deep gruff voice, asked, "Well, youngster, can you eat your weight in beef?" Little Downes, cocking up his eye, caught sight of this enormous man and with the self-possession of his years lisped back in a childish tremble, "No, thir, can you?" It was the genial whole souled officer who took the leading part in the laughter which followed this response.

I had the good fortune to serve on board his flagship, the Colorado, which sailed for Europe in the spring of 1865. The flag officer took a very keen interest in us midshipmen. I fear we regarded his interest with holy awe and much personal solicitude, much as his subjects regarded King Stork. Our consternation may be imagined when, walking the poop one day, he paused at its break, and looking down on some of us who were promenading the quarter deck, muttered, in what sounded to us as the tones of an ogre, "Ah, young gentlemen, how I should like to examine you;" and we immediately whispered to each other "The Lord forbid."

He had a great way at night while at sea of sending for the "gentleman of the watch," as the midshipman of the quarter deck was then called, and plying the latter with questions relating to the wind, the weather, the sail carried, the barometer, the thermometer, the course and speed of the ship, etc. It got to be a duel of wits in which, I must admit, the junior was invariably worsted, although sometimes the battle was long drawn out. Some point was always neglected and the old salt would discover it and chuckle in his berth as the rapier of his interrogation pierced the armor of our preparedness. One night Bob Caldwell

(dear fellow, I wonder where he is now) declared that he would have an answer for any question the admiral could possibly ask, for he had all the deck log and pretty much all the steam log committed to memory—but, alas, Bob counted without his host. At about five bells of the mid watch the summons came and down the ladder Bob shot full of confidence. He was gone a long while, but it was another and a different Bob who crept to the quarter deck, silent, vexed and depressed. It took much coaxing to worm the story out of him. "I told him the speed and course, the lights in sight, the local deviation of the compass, the barometer, thermometer, wet bulb and dry bulb, wind, force and direction, sail carried, weather, revolutions of the screw, steam pressure, vacuum, and a lot of other things, but he got me at last, blankety, blank, blank, when I couldn't give him the *temperature of the bilge injection!* And he lay in his bunk and just croaked like a blankety, blank, blank, old frog, blankety, blank, blank."

One day, during the summer of 1866, we were steaming down the English Channel over a sea as smooth as a mill pond, under a cloudless sky. The ship was under all plain sail, the breeze quartering and light. Nothing could have been more peaceful than the scene. It was the hour in the afternoon when the flag officer was accustomed to taking his constitutional on the quarter deck. Passing out of the gun deck cabin he glanced at the mercurial barometer mounted just inside the cabin door and, following his invariable practice, read the height of the mercury, something over thirty inches. With a serene mind he mounted the companion way to the spar deck, where he proceeded to pace up and down, throwing some of the lustre of his dignity upon everything which happened within his view. Shortly afterwards, the captain, whose stateroom adjoined the general cabin, for at this time the commander-in-chief, his fleet captain and the commanding officer of the Colorado messed together, being moved by the beauty of the glorious day, thought that he too would go up and see how things were getting along on deck. In his turn he also approached the barometer. He read its vernier and then began to examine more particularly into the construction of the instrument. Possibly some parts of its mechanism had never appealed to him before. However that may be, his evil genius directed his glance toward the screw at the bottom of the admiralty pattern by which the pressure on the leather bulb containing

the mercury is varied for the purpose of initial adjustment. Curious to know the purpose of this screw the captain ran it up and down two or three times seeking in vain a solution of the mystery when, unhappily, turning it too far to the left, a quantity of the mercury spilled out and ran over the cabin carpet. In dismay, but with great promptness, he hastily ran the screw up before very much of the liquid had escaped. After vainly endeavoring to make it read more than twenty-eight inches he went on deck, doubtless in great perturbation of spirit. An hour or so later old Goldsborough descended to the cabin and as he entered the door mechanically swung to the left to read the barometer afresh. To his horror during his brief abscence the mercury had fallen over two inches. Then there arose a clamor which pervaded every part of the ship, waking the captains of the holds and even arousing us midshipmen from our afternoon naps on the transom in the steerage. Call bells were ringing in all directions, orderlies were yelled for and sent on the run to the captain of the ship, to the first lieutenant directing the immediate calling of all hands to shorten sail, hasty orders reached the officer-of-the-deck to take in all canvas at once, put on sea gaskets and prepare for a gale, etc., etc., in fact in about two minutes the whole ship was a perfect bedlam and no one outside of the admiral knew what it all meant. In the meanwhile he was pacing up and down the cabin wanting, in stentorian tones, to know why something was not done before the fearful cyclone should strike us and carry us to the bottom. "God bless my soul," he ejaculated, "I never knew such a drop in the barometer in all my going to sea. It's horrible." In this turmoil the captain of the ship and the fleet captain took no special interest except that the former was zealously seconding his chief's efforts to make everything snug and to batten down the hatches while there was yet time, and the latter, writing in his stateroom at the time, had observed the mishap to the barometer occasioned by the inquisitiveness of the captain and being fond of a jest was inwardly chuckling over the whole commotion. It so happened that on one of his excursions to the forward bulkhead in the cabin old Goldsborough observed some globules of mercury lying on the cabin carpet and a moment's investigation revealed the true cause of his alarm. Mad as a hatter, he turned toward the fleet captain and bellowed out in a voice that would have done credit to a bull of Bashan case, "What d———d fool has been meddling with my barometer?"

The captain stepping from his room and pulling his long beard in a nervous manner in which his habitual hauteur was strongly tempered with deprecation, replied: "It was I, admiral, it was I." Things on board were speedily restored to their former condition of repose, but it was some little time before the secret of our sudden, strange and overwhelming disaster reached the steerage, and when it did the midshipmen felt as if the long score of despotism, tyranny, oppression, and maltreatment to which, in their midshipman way, they felt they had unjustly been subjected, was entirely squared. For once they had the joke on the "old man" and their glee, proportional to this unusual order of things, was manifested in methods appropriate to the occasion and common in those days to the steerage of a steam frigate.

One more story and I shall, for a while, doubtless permanently, quit this (to me) very attractive subject, but I hope that some one who had the pleasure of serving under him will tell the Institute a few of the many score of excellent stories relating to that picturesque individuality and able officer, the late Rear-Admiral S. W. Godon.

In spinning this last yarn about old Goldsborough, I am really broaching on the preserve of another, for it is my particular friend and classmate, Rear-Admiral C. H. Davis, who told it as happening to himself, to Rear-Admiral Jewell (I think) and one or two others of our mess of midshipmen on board the Colorado.

These youngsters had gone from Leghorn, where the ship was moored, to Florence on a short leave and not having grasped the opportunities of this great gem of the rennaissance concluded to ask for a twenty-four hours' extension. The captain not being in town it occurred to them, most unhappily, that Admiral Goldsborough, who was then stopping at the Hotel D'Italie, might be willing to grant their request. I am assured that the choice of a spokesman for the party was by no means easy, for each member firmly and repeatedly waived his privilege in favor of his neighbor. In some fashion or other Davis was selected to lead the forlorn hope. I have reason to believe that it was with many fears and tremblings that the party made their way to the admiral's hotel and sent up their cards. The admiral was a thoroughbred, a gentleman of the old school, and he received his youthful visitors with as much courtesy and distinction as if they had been princes of the royal blood, making them entirely at home and expressing himself as greatly flattered by their polite atten-

tion. They had been ushered in by the admiral's body servant, "John," who discreetly retired through the doorway into the adjoining room, but who, in this instance, as on all others, kept himself within call. The admiral asked these midshipmen where they were staying, how they enjoyed the place, what museums, galleries and churches they had visited, how they liked the opera and he drew upon his abundant store of history and anecdote for their instruction and edification. All the while they were shaking in their boots lest it should transpire that the object of their call was not so much to pay honor to their commander-in-chief as to ask a favor at his hand. Gradually screwing up his courage to the sticking point, Davis, after many hems and haws, gradually working round to the object in view, hinted that Florence contained so much that was valuable and instructive as to require rather a longer stay in order to do it full justice and offered the humble request that the party be allowed to remain another twenty-four hours. Stiffening himself with more than official rigidity, the admiral glowered at the unfortunate midshipmen from beneath his overhanging brows and deigned no response other than to say in imperative tones "The door, John, the door." Exeunt four crestfallen midshipmen hurrying to catch the first train back to Leghorn.

Admiral Goldsborough possessed a great fund of service anecdote upon which he was wont to draw from time to time for the edification of his guests. If he has left written memoranda or journals describing the life in the old navy they would be of great value. One of his yarns which I remember hearing him tell illustrates the condition of things in the first half of the last century. The scene is the Bay of Naples, upon whose calm, blue waters the seventy-four gun-ship Columbus is riding at anchor, her lofty masts in line, stepped with a rake increasing from forward to aft as was the custom of those days, her yards square, her sails neatly furled and rigging taut, the awnings spread in one flat sheet from stem to stern, her running gear flemished down on the deck in coils, whose patterns varied according to the æsthetic tastes of the different "Captains of the parts of the ship." The mainmast-man with his multitudinous ropes differing entirely in his opinion of what is beautiful from the less artistic rough-handed "Captain of the fo'casle." The boats

of the ship had been exercising under sails, as well as oars, during the forenoon and at lunch time the events of the drill were discussed with animation at the ward-room mess. "Jimmie" Glynn, the second lieutenant, was very loud in his praises of the third cutter and of the great abilities and perfect training of her crew of negroes commanded, be it understood, by the same Jimmie who it was, as some still remember, in 1855, when the so-called "Star Chamber Board" was formed, expressed to Matthew C. Perry, its president, his hearty approval of the scheme, adding, "Don't forget, Perry, be sure and cut deep," and Perry did cut deep,—in fact just below Jimmie, who with many others was summarily retired. Jimmie was a little chap and like most small men the earnestness and vigor of his arguments were only rivalled by the shortness of his stature. Now, to some members of the mess, Jimmie's eulogy of his boat's crew savored of the vainglorious, so much so that the late Rear-Admiral F. H. Gregory, who was the first lieutenant, felt called upon to restrain Jimmie in his remarks. "You are boasting, Jimmie, and I am afraid we will have to cut your comb." "Oh! no, Mr. Gregory," said Glynn, "I am not boasting, I am only telling the solemn truth." "Jimmie, if you don't stop bragging about your boat's crew I shall give you a lesson you will never forget." "Well, I do not know about that, Mr. Gregory, but I do know my boat's crew can out-pull and out-thrash any other in this ship." "Nonsense, Jimmie," said Gregory. "I will take the first cutter, pull all around you, chuck your crew overboard and yourself too, and tow you alongside the ship stern first." "I would like to see you do it," said Jimmie. "Well, all right," said Gregory. "We will try it after the hands are turned to." In those days any duty outside of the ship involved the wearing of cocked hat and epaulettes, so when Jimmie manned his boat and shoved off from the starboard gangway, he was in, what we would now consider, full uniform, standing up proudly in the stern sheets of his cutter, which pulled out a short distance and then lay on its oars waiting for its challenger. Gregory mustered the first cutter's crew in the port gangway after Glynn had shoved off. They all wore, what was habitual at that time in cool weather, short monkey jackets over blue shirts. "Go down to the purser," said Mr. Gregory, "tell him to give you some black pepper and put a handful of it in your pockets every one of you and then

come back here." So said, so done. In a few minutes the first cutter was manned and Gregory was pulling around the stern of the ship to line up alongside of Glynn in his second cutter with her dusky crew. He passed between the ship and the second cutter and then around the latter, thus carrying out his original prediction, and when he got well to windward he first held water, then lay on his oars and then ordered his crew, "Now, boys, give it to the darkies." In an instant the second cutter's crew were all weeping and gasping and sneezing, their eyes blinded with the pepper. "Now then, first cutters," said Gregory, "board them and throw them all overboard," which was done, leaving only Jimmie standing in the stern sheets surprised by the strange and unexpected nature of the attack. "Throw Mr. Glynn overboard," said Gregory. "For God's sake don't do that," said Glynn. "Yes, Jimmie," said Gregory, "you bragged too much a while ago and you have got to have your lesson." Over with him lads, but give him a painter so that he may have something to hang on to." So the first cutter's crew put the painter in Jimmie's hand and chucked him into the water. His boat was then towed stern first back to the ship, the crew in the water hanging onto the gunwales and the gallant Jimmie bringing up the rear, clinging to the painter.

It was thus in the thirties and forties that the boaster was humbled—but, it might be suggested, "nous avons changé tout cela."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

FREEDOM OF DISCUSSION IN THE INSTITUTE PROCEEDINGS.

By PROFESSOR PHILIP R. ALGER, U. S. N.

On the title page of the PROCEEDINGS OF THE U. S. NAVAL INSTITUTE these words are printed: "The writers only are responsible for the contents of their respective articles."

Nevertheless all articles submitted for publication in the PROCEEDINGS are read by the members of the Board of Control of the Institute and must be approved by them before acceptance. That is to say, it is the duty of the Board of Control to refuse to publish anything deemed prejudicial to the best interests of the Navy or the Institute.

The same practice is usually followed in regard to discussions of articles which have appeared in the PROCEEDINGS, but, as the expressions of individual opinion submitted in this form are seldom entitled to the weight attaching to carefully prepared articles—and especially since these discussions were originally open debates in a meeting at which the article discussed had been read—there has been very naturally a tendency to permit greater latitude of statement in discussions than in other contributions to the PROCEEDINGS.

There is a proper limit, however, to freedom of discussion, and when an officer of any one corps, availing himself of the privilege of setting forth his opinions in the pages of the INSTITUTE PROCEEDINGS, brings charges of inefficiency against other officers or other corps that limit has been exceeded. Neither independence of thought nor independence of speech need be fettered by observing due respect for every branch of the naval service.

In the last half page of a discussion of the prize essay for 1904,

printed in the September issue of the PROCEEDINGS, there were allowed to appear through inadvertence, severe reflections upon the Ordnance Department, the Corps of Naval Constructors, and the officers in charge of the distribution of the personnel. The author gave no proof other than assertion of the inefficiency which he lightly charged against three of the Bureaus of the Navy Department, but he attributed it to insufficient control of naval affairs by "sea-going officers."

As a matter of fact, however, the Bureau of Ordnance and the Bureau of Navigation are and always have been entirely controlled by sea-going officers, and in no other navy in the world have line officers so completely governed in all matter concerning both matériel and personnel as they have in the United States Navy.

The Board on Construction has always had a majority of line officers; the Secretary of the Navy has, I believe, always supported that majority when it was united; and, what is much more important to the good of the service, the minority of that board has for many years past always stood ready to do its best to carry out the wishes of the majority—to build the ships which the sea-going officers asked for.

I express the opinion of all the members of the Board of Control of the INSTITUTE, and I believe that of the great majority of the sea-going officers of the navy, when I say that such charges should never have been made.

DISCUSSION.

"Training Ranges and Long-range Firing." See No. 111.

Captain Percy Scott, R. N.—

H. M. S. Excellent,

Trafalgar Day, October 21, 1904.

I have received from America a copy of a paper on the subject of training ranges and long-range firing read at the Naval Institute, Annapolis, by Lieutenant-Commander W. Sims, United States Navy.

Lieutenant Sims, I believe, holds the office of Director of Naval Target Practice in America, and is chief adviser to the Bureau of Ordnance on all matters connected with naval gunnery.

I wrote to America and asked how Lieutenant Sims got the post; the reply was as follows:

"The United States Bureau of Admiralty were in full belief that Lieutenant Sims had carefully studied the subject, and was thereby able to arrive at correct conclusions. They at once decided not to fool round with the cloud of opinions on file from officers who had only considered the matter incidentally, but to be guided by his advice."

I met Lieutenant Sims in China; he was then busy bombarding his Admiralty with suggestions for improving the shooting of the American fleet, and got permission from his commander-in-chief to demonstrate the stupidity of carrying out practice with heavy guns on a principle which enabled the layer to get a maximum score without ever hitting the mark aimed at, and he succeeded in establishing in the American fleet that the word hit should mean that the projectile had come in contact with the mark aimed at.

While Lieutenant Sims has been in office, the American navy has made such gigantic strides towards efficiency in heavy gun shooting that I think we must regard him as an artillerist of note.

Like all Americans, he is full of brains and full of humor, and sets forth his doctrines so logically and clearly that not to agree with him is an indication of dulness of intellect, or to use his own expression, chronic cerebral inactivity.

It gives me great pleasure to read some extracts from his paper to you; it should, in my opinion, be studied by all officers interested in gunnery training, perhaps more particularly by those who are in favor of training the layers to carry out long-range firing without the necessary assistance of spotting from aloft, and those who advocated the increase of range in our gun-layers' competition, which has converted it into a question of luck instead of comparative test of skill.

The paper also will be beneficially read by those who are in favor of training men at a towing target, which if you hit you cannot for a cer-

tainty see that you have hit, and the rules of the practice give a man just as many points for a miss as for a shot going through the centre of the bull, the man's final qualification depending upon not having hit the target but upon someone's estimation of where his misses have gone.

A year ago we abolished towing target practice, but I am sorry to say it has just been re-introduced. I hope it is only a temporary measure.

Lieutenant Sims deals very lightly with this theoretical method of crediting hits, for the United States Navy have long since discovered that from it, as he says "the pointers learned almost nothing."

I hope that we shall soon also discover that from it our pointers learned nothing, and adopt, as the Americans have done, "hit or miss targets."

Lieutenant Sims' comparison between the pointer and the marksman is, I think, very clearly put, and should be very interesting reading to those officers who wish to tax the bluejacket's brains with approximate rules for change of range and arithmetical calculations of angular speeds; he shows that when fighting at ranges where arithmetic must be done, the calculations should be made by the officer conning, and that the only duty of the layer is to keep his gun pointed straight.

I have just seen a British anonymous pamphlet, in which the writer says that "no gun-layer or sight-setter can be considered efficient **unless he understands how to calculate rate of change of range**"; he then gives five pages of rules for calculating the rate, finishing with the following recapitulation:

RECAPITULATION.

"To recapitulate, it will be noticed that there are four figures that the gun-layer must always have in the back of his mind. Of these the first two are the speeds of the two ships. By adding or subtracting these, and occasionally reducing one or both by ¼, ½, or ¾, he arrives at his deflection. From the speeds he gets the other two important figures —the minimum rates of change of range of the two ships. By multiplying these by 1, 2, 3, or 4, according to bearing, he gets the two actual rates of change; by adding or subtracting these, according to whether they are 'opening' or 'closing,' he gets the combined rate of change."

I do not think that any useful calculation to find the rate of change of range can be made without the use of a stop watch, or some sort of mechanical instrument, and as the layer and sight-setter have only two hands each (which are fully employed), it is obvious that they could not manipulate any instrument.

If a visual instrument is provided, it would not be of much use to the layer, as he has only two eyes, one of which is at the telescope, and the other is shut; the sight-setter also only has two eyes, and they are fully occupied in observing the deflection and range scales of his sight.

Without another eye he would, I think, be unable to look through the case-mate port to obtain the necessary data for the mental arithmetic, which the writer recommends in his five pages of rules.

The sight-setter in a turret would be worse off, as he could not see the enemy at all.

In order to calculate the rate of change of range, it is necessary to know your own speed, the enemy's speed, and your own course and the enemy's course, and the enemy's bearing.

With this data, and the aid of a stop watch or instrument, the triangulation can be worked out.

From the foregoing reasoning it is obvious that neither the gun-layer, sight-setter, nor any other seaman who is working the gun is in a position to obtain the necessary data. It may therefore be definitely stated that, although this calculation **has to be made**, it can never be made by any of the seamen working the gun; it must be made by someone who is not actually taking part in the loading and laying of the gun, and hence there is no necessity to burden the brains of the men who are loading and laying the gun with five pages of printed instructions on a subject **which does not concern them.**

The statement that "no gun-layer or sight-setter can be considered as efficient unless he knows how to calculate rate of change of range" shows, to use Lieutenant Sim's language, that the writer **has not taken the pains to analyze the basis of his convictions.**

Lieutenant Sims deals very ably with the relations which should exist between the size of the target and the range; he does not mention that, in a competition which concerns the men only, the range should not exceed the distance at which hits on the target can be seen. I suppose that he considered that it was unnecessary to allude to such an obvious fact.

NOTE.—It is argued by some that at a certain stage of any action, gun-layers will be "on their own," i. e., they will have to hit the target by their own unaided efforts.

This may be; but it is obvious that neither the sight-setter nor the gun-layer can calculate the change of range, hence they are the last people in the world to whom the theory or practice of allowing for change of range should be taught.

Lieutenant Sims remarks that with reliable pointers long-range firing becomes a training in range finding and range keeping. He says you must first train your pointers to aim accurately, then train your ship to get the maximum results out of their skill.

In the gunnery schools all we can do is to train the pointers in their part of long-range firing, the sea-going ships must do the remainder, and some of them are doing it well, take the "Good Hope" for example.

Recently the Admiralty asked a question: "Are spotters recommended?" The reply was "No. Special spotters are not recommended." My reply would have been "Yes, they are." As finding and keeping the gun range can be only done by good conning, every endeavor should be made to give our officers training which will enable them to accurately spot where the shot go, and those officers who show a special aptitude in spotting should be regarded as officers of great value to the state.

To support my opinion I should have quoted the case of Lieutenant Litchfield, who is a good spotter and as a result, every ship he goes to becomes the best shooting ship in His Majesty's Navy.

Long-range firing can be split up into four factors:

1. Efficiency of the layer.
2. " " spotter.
3. " " mean of keeping the range.
4. " " communications.

All four are equally important, as failure in one means failure in all: to attempt to carry out long-range firing without efficiency in 1 and 2 and reliability in 3 and 4 will be, as Lieutenant Sims puts it, "*inexcusable waste of ammunition.*"

Of the four factors which make up long-range firing we in the training schools are responsible for No. 1; No. 2 the sea-going ships are responsible for; and those who provide us with our material are responsible for 3 and 4.

Lieut.-Commander ROY C. SMITH, U. S. Navy.—Lieutenant-Commander Sims has in this paper made a very clear and scientific demonstration of the futility of long ranges for purposes of ordinary training. There is in the service a good deal of the old "marksman" idea of shooting. Now however, it must be clear that what we want is pointers, not marksmen. The men must "point" where directed. If they do not, their misses cannot be corrected. They cannot themselves see where their shots go, and if they do not set their sights at the ranges, and with the allowances ordered, then no one else can correct their misses. The pointer must be almost automatic. He must obey orders as to the setting, and then his sole duty is to get the target on the cross-wires. The officer directing the fire of the battery must be the one to see where the shots are falling, and must vary that point of fall as the fireman does his hose stream, only instead of playing the nozzle, he orders slight changes in vertical and lateral sight setting. The pointer does the rest. To train the pointers to carry out these ideas, it is evident that we need a target on which a good shot can see what he is doing. After that the range and size of target are simply questions of limit of error inherent to the battery itself and size of target that can be handled in ordinary conditions of weather on the firing range. It is safe to leave the actual figures to the inspectors who have most to do with the practice.

THE CAMP OF SANITATION AT LEAGUE ISLAND. See No. 110.

Captain CHAS. M. THOMAS.—Referring to the PROCEEDINGS OF THE UNITED STATES NAVAL INSTITUTE, No. 110, June 1904, Vol. XXX, No. 2, page 312, last paragraph of "The Camp of Sanitation of League Island" I take pleasure in forwarding a copy of my instructions for a sanitation camp on the St. Helena Reservation, Navy Yard, Norfolk, Va., during an epidemic of diphtheria in the early spring of 1903, for publication in the PROCEEDINGS as a part of the discussion on the very able article by Rear-Admiral Goodrich.

U. S. R. S. FRANKLIN,
Navy Yard, Norfolk, Va.,
April 11th, 1903.

General instructions for the disinfection of the enlisted personnel, their clothing and bedding, and the establishment of the encampment upon the St. Helena Reservation during the prevailing epidemic of diphtheria.

1. (*a*) The senior medical officer to have general charge of the disinfection, fumigation, washing of clothes, bathing, and assignment of men to the several camps.

(*b*) The junior medical officer to have special charge of the disinfecting plant, drying house, bathing and disinfection of person.

(*c*) The executive officer will have general charge of mustering the men before medical inspection, and will give the necessary directions for the carrying out of all recommendations made by the senior medical officers; will supervise the several camps, and make such military organization in each camp as will be most conducive to discipline, the comfort and convenience of inmates, and the strict observance of the senior medical officer's advice.

2. The several camps will be known as follows:

No. 1.	Distributing camp.	(Men held over night).
No. 2.	Clean camp.	(Men available for transfer).
No. 3.	Infected camp.	(Men held for developments).
No. 4.	Hospital camp.	(For developed cases).
No. 5.	Prison camp.	(For clean prisoners only).

Infected prisoners will be assigned to one or more tents specially designated in camp No. 3.

3. When all the above enumerated camps are ready for occupancy, the following procedure, prepared with the advice of the senior medical officer, will be strictly observed:

(*a*) Order of physical examination:

1st. Those now in camp hospital on St. Helena.
2nd. Prisoners from St. Helena Brigade.
3rd. Landsmen for training in the numerical order of divisions, commencing with the first.
4th. The recent artificer class.
5th. The general detail.
6th. The marine guard.
7th. The regular complements of ships.

(*b*) The obtaining of cultures will be under the direct supervision of Surgeon Thomas A. Berryhill, U. S. N., of the Naval Hospital at this station.

(*c*) A designated detail, with bedding and all personal effects, will be mustered for physical inspection on board the Franklin or Richmond after the dinner hour, and cultures will then be taken; immediately after which, the men so treated, with all their effects, will be sent to the disinfecting plant, the party being in charge of the regular divisional officer, and will there deposit clothing, etc., in charge of the junior medical officer, with the exception of mattresses and blankets, and the white working suit then being worn. This being done, the party will proceed at once to camp No. 1 for isolation, remaining in this camp, under guard, until after the dinner hour of the following day. Supper, breakfast and dinner to be sent to this camp.

(*d*) Under the supervision of the junior medical officer in charge of the disinfecting plant, all white clothing, white hats, underclothing, bags and hammocks (mentioned in "c") will be placed in a solution of 1-1000 bichloride placed outside of the plant; and all blue clothing, watch caps, and flat caps, will be placed upon lines within the plant for fumigation the following morning.

(*e*) Steam to be circulated in the drying house (rifle range) by 5 a. m. each day.

(*f*) Such men as have been confined in camp No. 1, will, during the early forenoon of the second day, proceed to the disinfecting plant, taking with them their mattresses and blankets, and leave them there in charge of the junior medical officer, and receive from him their personal effects which have remained in soak in bichloride solution over night; then proceed to the wash-house and thoroughly wash the same in fresh water, wring dry each piece and place it upon the table-bench nearest the tub; and, when this is done, the party will return to camp No. 1. The enlisted medical staff under the supervision of the junior medical officer, will collect the washed clothing from the wash-house and remove the same to the drying house, where the several pieces will be placed upon the lines for drying. The mattresses will be hung up within the disinfecting plant for fumigation; the blankets and mattress covers will be soaked in bichloride solution, and, after one hour, the blankets and mattress covers will be removed and placed in the drying house; the disinfectors will be lighted.

(*g*) Shortly after the dinner hour of the second day, and when report has been received from Surgeon Berryhill, the bacteriologist, showing the result of his examination, the men in camp No. 1 will be divided into two squads, clean and infected, and the following disposition will be made of them:

I. The clean squad to proceed at once to the bath-house; each man will thoroughly bathe; then be disinfected with 1-1000 solution of bichloride on the person, under the supervision of the junior medical officer; will then dress in a suit of white working clothes that has been disinfected, leaving his former suit of clothes, recently removed before bathing, in charge of the medical staff for future disinfection and return to the owner. The men of this squad, after dressing, will at once proceed to camp No. 2 and carry with them their personal belongings which have been disinfected and fumigated.

II. The infected squad will receive their personal effects of every description and will proceed to camp No. 3 or camp No. 4, according to the seriousness of infection, to be determined by the senior medical officer. The men of this squad will not be allowed to go near the bath-house, nor will they be required to shift into disinfected clothing previous to proceeding to their permanent camp.

4. For the purpose of identification, all men assigned to camp No. 2 will wear white hats; those assigned to camp 3 or 4 will wear watch caps; the enlisted personnel of the medical staff will wear the Geneva Cross bade upon the left arm.

5. No communication will be permitted between the inmates of the several camps.

6. The men assigned to camps No. 2 and 3 will be organized into divisions, and the men in camp No. 2 will be regularly drilled, and camp discipline will be strictly enforced.

7. The several divisions composing camp No. 2 will be marched to and from the mess hall for their meals.

8. Meals will be sent from the ships or cook-house to camps Nos. 1, 3, 4 and 5 by the navy yard wagon and push-carts, and the wagon will be used for the distribution of water.

9. Marine sentries will be established as the camps are being formed, and in such number of posts as may be found necessary.

10. The Franklin's band will play the morning and evening concert on the parade ground, near the grand stand.

(SGD.) CHAS. M. THOMAS,
Captain, U. S. Navy.
Commanding U. S. R. S. Franklin.

Approved:
(SGD.) P. F. HARRINGTON,
Rear-Admiral, U. S. N., Commandant.

SOME REMARKS ON THE ADMINISTRATION OF JUSTICE IN THE NAVY.

See No. III.

By Rear-Admiral C. F. GOODRICH, U. S. Navy.—Lieut.-Comdr. Hood's "Remarks on the Administration of Justice in the Navy" are admirable. The remedy he seeks lies not in a change of service public position but in a change in the status of officers themselves. Give an officer who feels that an unmerited stain rests upon his reputation the *right* to be tried by a court-martial of whose members a large minority shall be of his own selection, and the navy will look upon courts as a blessing to the innocent rather than as "organized to convict." Naturally there should be a geographical limit to the field of the (accused's) absolute selection of members which should not extend to more than, say, five hundred miles on shore or beyond the personnel of the squadron at sea. He should himself frame the charges upon which he wishes to be tried, while the Department could add as many more of its own as it deemed expedient. Naturally some safeguard should be provided against the exercise of this right in merely trivial cases. Thus, should the Department regard any one instance as frivolous, the decision might be left to a board of three officers, the aggrieved naming one, the Department the second, and these two adding the third. Their verdict of "court-martial not warranted" would itself be a pronouncement in favor of the suitor for redress. What is needed in such matters is not only substantial justice but the undoubted evidence and appearance of complete impartiality. I refrain from entering upon details.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS, AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Erzherzog Karl	10,600	Trieste.	Launched Oct. 4, 1903.
Erzherzog Friedrich	10,000	"	" April 30, 1904.
C	10,600	"	Projected.
Armored Cruiser.			
Saint Georg	7,400	Pola.	Launched Dec. 8, 1903.
River Monitors.			
Save	450	Neupesth.	Launched March 25, 1904.
Theiss	450	"	" " " "

The budget for the Austrian navy for 1905, including ordinary and extraordinary charges, amounts to 51,026,410 kr., while there is a supplementary estimate of 22,000,000 kr. for new construction, guns, coal, etc. The sums include the final instalment for the cruiser St. George, a fifth instalment for the battleship Erzherzog Karl and the Erzherzog Frederick receives a fourth instalment. The battleship C receives a second instalment.—*Page's Weekly.*

Messrs. Yarrow, of Poplar, who have just secured an important contract from the Austrian Government for the building of a large number of torpedo-boats and torpedo-boat destroyers, have decided to follow the design adopted in the case of the Japanese torpedo-boats turned out by the firm, and which have proved so successful. The new boats, with the exception of the introduction of some slight modifications and recent improvements, will be almost identical in size and tonnage, and this design has been preferred to the new craft designated "scouts" now being constructed by various firms to the order of the British Admiralty. Altogether the contract embraces the construction of some 30 boats of both classes, although this number may be exceeded at a later date. The new boats will be of sufficient power and capacity for ocean going purposes, and will be a valuable addition to the Austrian navy, which comprises some fine battleships, but which hitherto has been rather weak in this particular class.—*United Service Gazette.*

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
République	14,865	Brest.	Launched Sept., 1903.
Démocratie	14,865	"	" May 2, 1904.
Patrie	14,865	La Seyne.	" Dec. 17, 1903.
Justice	14,865	"	" Oct. 27, 1904.
Vérité	14,865	Bordeaux.	Building.
Liberté	14,865	St. Nazaire.	"

VESSELS BUILDING—*Continued.*

Name.	Displacement.	Where Building.	Remarks.
Armored Cruisers.			
Ernest Rénan,....	13,562	Brest.	Building.
Jules Michelet.....	13,562	Lorient.	"
Jules Ferry.....	12,550	Cherbourg.	Launched Aug. 23, 1903.
Victor Hugo.....	12,550	Lorient	" March 30, 1904.
Léon Gambetta.....	12,550	Brest.	Under trial.
Sully.....	10,014	La Seyne.	" "
Dupetit Thouars.....	9,516	Toulon.	Under trial.
Edgard-Quinet	14,300	Brest.	Ordered.
C 17.....	14,300	....	Authorized.

The armored cruiser C 16, which is to be built at Brest, is to be named the Edgard-Quinet, for reasons which we shall not attempt to discover, but which are doubtless the same that caused such names as Ernest Rénan and Jules Michelet to be selected. We suppose that Brueys and Ganteaume, and some other French seamen who fought bravely, if not always successfully, in their country's cause, are forgotten. The new cruiser will displace 14,300 tons, being of an entirely new type, and the largest cruiser yet laid down in a French yard. The length will be 528 feet, the beam 70 feet 3 inches, and the maximum draft 27 feet. She will have engines with an aggregate of 40,000 horsepower, and the speed will be twenty-four knots, and not twenty-three, as was originally proposed. The coal capacity will be 1500 tons, with 2400 tons as a maximum, and the range of action at ten knots will be respectively 7000 miles and 12,000 miles, and at the maximum speed 1100 miles and 1700 miles. The armament will comprise two 9.4-inch of the 1902 model, which has a penetration equal to the old 12-inch; sixteen 6.4-inch, not coupled in turrets as in some other French ships; eight 2.5-inch, sixteen 1.8-inch, and two 1.4-inch. The ammunition supply will be largely increased as compared with other French cruisers,* and will be even greater than in the recent battleships. Four of the 6.4-inch guns will be placed in a central redoubt. The protection of the Edgard-Quinet will be equal, or slightly superior, to that in the Léon Gambetta and Jules Michelet classes, but the gun protection will apparently be somewhat less. The complement of the cruiser will be 696 officers and men. These particulars differ somewhat from those previously given. The changes introduced into the plans have chiefly the effect of giving greater speed and range, and the principal change in regard to the armament is in substituting two 9.4-inch for four 7.6-inch, and increasing the 6.4-inch guns from twelve to sixteen in number, and in adding the eight 2.5-inch. We do not think that this new cruiser can be considered equal to the Duke of Edinburgh, which will have six 9.2-inch guns, although her speed is intended to be superior. Speed, however, is so elusive, and the final knot costs so much to attain, that we should question the wisdom of the design. Many particulars are, however, wanting for any final judgment.—*Army and Navy Gazette.*

The work upon the French armored cruiser Jules Ferry has been so far advanced that a captain has been appointed to supervise the work of completion. At Lorient the Victor Hugo has been brought under the great sheer-legs, which are capable of lifting 150 tons, in order that her boilers and armored conning-tower may be hoisted in. This work is being supervised by a chief engineer, and presently a captain will be appointed to the command. The cruiser Friant, which was the first in the French fleet to receive Niclausse boilers, is to have them renewed. She was constructed at the same time as the Bugeaud, which has Belleville boilers, and the Chasseloup-Laubat, which vessel has boilers of the Lagrafel and D'Allest

*150 rounds for each 9.2-inch gun, 295 rounds for each 6.4-inch gun, and 500 rounds for each 65-mm. gun. P. R. A.

type. The three vessels have been in commission on the China station, and the time had come when it was necessary to give them new boilers. This has already been done in the Chasseloup-Laubat, and the Bugeaud will be put in hand.—*Army and Navy Gazette.*

The Gambetta, reconstructed after her recent accident, has just been running trials at Brest. With sixteen of her Niclausse boilers lighted she reached 15,000 horsepower at 105 revolutions. As the result of this trial it is announced that neither engines nor boilers appear to have been affected by the recent grounding.—*Engineer.*

The extensive organization and practical value of the French submarine flotilla are not fully realized in this country, and thus it will be useful to review the position, especially in relation to the tactical distribution of the units. There are afloat eight submersibles—vessels which float nominally on the surface, diving only to strike—and 32 submarines, which never show more than a conning-tower above water level. These vessels are varied in their size and design, due to the desire for experimental research towards the highest efficiency and excusable on the plea that since tactics vary so may types differ. There are, of submarines, seven separate types—the Gymnote of 33 tons and 8 knots speed, the Gustave-Zédé class of 267 tons and of 12 knots speed, the Morse class of 141 tons and 12 knots, and the later classes—the Loutre of 68 tons and 8 knots, and the Farfadet of 185 tons and 12½ knots. Three experimental submarines are being built, ranging from 168 tons to 213 tons and of 11 knots speed. Of submersibles there are three separate classes—the Narval type of 106 tons displacement on the surface and 206 tons when plunging, the Aigrette class of 172 tons, and the Omega type of 301 tons and all of 11 knots speed. The tendency, it will be noted, is towards higher displacements, and in submarines proper the same remark applies even in a greater degree, as the six vessels to be built under next year's programme would be of 422 tons and of 12 knots speed. Fourteen other vessels are authorized, but it has not been determined whether they will be submarines or submersibles. Thus, by 1907, France will have 60 of these new ships of war—a greater number than any other nation, and almost three times the number possessed by Britain.

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And now for the tactical distribution of the flotilla. The allocation of the units has been determined with due regard to the distance which they may traverse in action and to other similar considerations. At Dunkirk there will be four submarines of greatest tonnage, and therefore longest radius of action. A glance at the map indicates the significance of these facts. At Cherbourg there will be seven submersibles, again of the largest size, and intended for offensive rather than defensive tactics, and two submarines for the defence of the harbor and against containing fleets. At Toulon there will be six submarines and two supbmersibles of the Omega class. In Corsica, Algiers, Cochin-China, Tonkin, Diego-Suarez, at Sousse, and at La Goulette there will be two or three submarines; and finally at Bizerta, from whence raids can be made on Malta, there will be three submarines of the greatest size and radius of action, corresponding to the raiders at Dunkirk. The bases have been determined with due regard to the points most exposed to attack or best situated for offensive action. Other points will receive attention when the fleet has been augmented.

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The *Armee et Marine* announces that the three French torpedo-boats fitted with turbines are not of the same but of different types. No. 243 has Renard turbines, No. 293 Parsons turbines, and No. 294 Brequet turbines. It is intended to experiment with these boats in order to see which type is the best.—*United Service Gazette.*

It is announced that as a result of an interim report of the French Parliamentary Commission, which has preferred the submersible to the submarine, two submersibles, 164 feet in length, are to be built at Toulon from the designs of M. Laubeuf. Orders have also been given for two first-class torpedo-boats, similar to Nos. 225 and 226, which have given excellent results at their trials.—*Army and Navy Gazette.*

The persistence with which the French reconstruct their old ships is exemplified in the case of the old monitor Furieux, which has just run her trials with considerable success. She has been re-armed with modern 9.4-inch in single turrets fore and aft. The old engines have been retained, but Bellevilles have been substituted for the old boilers. On her trials at Cherbourg she developed 5145 indicated horsepower, and a speed of 14.345 knots, with 91 revolutions. This speed is about half a knot more than she realized on her first trials, and the apostles of reconstruction are correspondingly delighted.—*Engineer.*

The *Yacht,* in a recent article, draws attention to the bad results obtained in the government dockyards:

"We are no longer in the 'wooden age,'" proceeds the writer, "during which France acquired universal renown by the skill of her workmen and the rapidity with which her ships were built. In the 17th and 18th centuries the launch of a three-decker of 110 guns, like the 'Royal Louis,' after being only five months on the stocks, was the admiration of Europe; and when the celebrated naval architect Blaise Ollivier was sent on a secret mission to England and Holland to report on the methods employed in the yards of those countries, he was able to state on his return that, as far as naval construction was concerned, France was in every way superior to her rivals.

"We could make no such claim in these days without making ourselves ridiculous. It is only too true that our dockyards construct not only more slowly, but also more dearly than most foreign yards. According to official documents, the mean cost per ton of a battleship is:—In England, 1,700 francs (£68); 2000 francs (£80) in Italy; and 2300 francs (£92) in France. There is more: The net cost of ships constructed in our dockyards is higher than the selling price for ships built for the State in private yards. The Carnot and the Bouvet, two battleships built in the dockyards, cost 28,000,000 francs (£1,120,000) and 28,700,000 francs (£1,148,000) respectively, while the Masséna, a nearly similar ship, built in a private yard, only cost 26,500,000 francs (£1,060,000). Moreover, the displacement of the Masséna was 12,300 tons, that of the Carnot and Bouvet only 12,000. When one considers that the shipbuilding firms which build for the government have to pay not only their general expenses, but also dividends to their shareholders, one is amazed at the economic inferiority of the State dockyards.

"For a long time past very severe and well-justified criticisms on this matter have been uttered both in the Chamber and the Senate, and yet the evil still grows. We wish to show to-day how the hopes of reformers will be frustrated as long as we do not retrace our steps from the fatal declivity down which the navy for some years has been gliding. What is the good of advocating salutary reforms, not to mention the fitting the dockyards with modern plant, such as is used in private yards, when the line of conduct followed by Ministers and Parliament takes them absolutely and more and more from the right path?—*United Service Institution.*

The difference between the cost of French-built and British-built ships is very clearly shown by the cases of the Jurien de la Gravière and the Hermes. The former commenced at Lorient in 1897, was commissioned for the first time in 1902; the latter, built by the Fairfield Company, was laid down at the beginning of 1897, and put into service two and a half years later. In many respects the vessels are similar, but the cost of the Hermes was £278,349, while the cost of the Jurien de la Gravière, exclusive of armament, was £400,201.—*Page's Weekly.*

The Victor Hugo, which was laid down at Lorient on July 16 this year, is progressing rapidly; her belt of 116 plates is almost complete.

Forty-eight more torpedo-boats are to be put in hand, all but two of them being contracted for by the private companies at Nantes, Bordeaux, Havre and other places, the other two being built in the dockyards. France is also about to experiment with scouts of 1600 tons displacement, 3800 horsepower, and 18 knots speed. These have been designed by M. Bertin for a radius of action of 7300, and their armament is to consist of four small quick-firers and seven torpedo tubes, of which two will be submerged. It is not stated how many of these are to be laid down first, nor is information given as to the date of commencement.—*Page's Weekly.*

The French naval authorities do not seem yet to have reached a solution of the problem whether the submarine or the submersible boat should be preferred; and there seems a doubt whether the commission appointed to answer the question will be able to satisfy expectations, as their tests were made in too calm weather to settle seagoing difficulties. It is now urged that exhaustive trials should be made with the latest and best representatives of the two classes—the Aigrette, a submersible designed by M. Lanbeuf, a naval engineer, against the improved Gustave Zédé, known officially as Z., designed by another engineer, M. Maugas. The particulars of these two boats are of interest. The Aigrette, now being completed, is of 172 tons displacement, being 117 feet 7 inches long and 12 feet 9 inches broad, and she has a Diesel oil motor of 185 horsepower for propulsion on the surface and for charging the electric accumulators. The speed on the surface is 8½ knots with the motor indicating 174 brake horsepower, and under the surface 6.1 knots with the electric motor giving 147 horsepower. The Z., on the other hand, is of 202 tons displacement, the length being 135 feet 8 inches and the breadth 9 feet 10 inches. But when submerged a speed of 11 knots is claimed for her when the motor is developing 190 horsepower. The dimensions indicate a very different form, which may enable the greater speed to be achieved with this relatively small increase of power; but there are those who doubt whether 11 knots can be maintained. The time taken in immersing the Z. will be very much less than the four minutes required for the Aigrette; but against this it is claimed that the vessel is less stable, less habitable, more complicated in its mechanism, and more costly. The consumption of oil of the motors for such boats is put at 3 lbs. per horsepower per hour, which seems high.—*United Service Gazette.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Preussen	13,200	Stettin.	Launched Oct. 31, 1903.
Hessen	13,200	Kiel.	" Sept. 18, 1903.
Lothringen	13,200	Dantzic.	" May 27, 1904.
Deutschland	13,200	Gaarden.	" Nov. 19, 1904.
O	13,200	Stettin.	Building.
P	13,200	Dantzic. (Schichau Works.)	"
Armored Cruisers.			
Prinz Adalbert	9,050	Kiel.	Under trial.
Roon	9,050	"	Launched June 27, 1903.
York	9,050	Hamburg.	" May 14, 1904.
F	9,050	Kiel.	Building.
G	....	Bremen.	"
Protected Cruisers.			
Hamburg	8,000	Stettin.	Under trial.
Berlin	8,000	Bremen.	Launched Sept. 22, 1903.
Munich	8,000	"	" April 30, 1904.
Lubeck	8,000	Stettin.	" March 30, 1904.
Ersatz Alexandrine	8,000	....	Ordered.
" Meteor	8,000	....	"

The naval estimates for the year 1905, as suggested in reports from semi-official sources, total £11,920,000 (M. 238,400,000). The recurring expenditure is estimated at £5,263,038 (M. 105,260,755), an increase of £297,512 (M. 5,950,246) over the previous estimates, and the non-recurring expenditure at £5,574,922 (M. 111,498,450). Of this latter sum £3,503,500 (M. 70,070,000) are required for new construction, and is to include first instalments for the battleships Q. and R. in the naval programme, one large and two small cruisers, a gunboat for foreign service, a river gunboat, and a mine-laying vessel. There is also reported to be a sum of £75,000 (M. 1,500,000) for experiments with submarines.—*Page's Weekly.*

The new battleships, of the Braunschweig type, slightly improved, to which reference was made last month, are to be known as the Commas class. They are to displace, as do the Braunschweigs, 13,200 tons, but both in armor-plating and armament there are marked differences. The armor-plating amidships is to be 9.4 inches thick, and the citadel plates are increased from 3.93 inches to 7.8 inches in thickness. The secondary battery, moreover, is placed not in rotary turrets, but in separate armored casemates. The main battery remains the same as in the Braunschweig class, but the smaller pieces are increased in number, there being twenty-two 3.43-inch light machine guns. Further particulars of these vessels are lacking, but it seems evident from the few facts known, that while the Commas is a great improvement on the Braunschweig and her sisters, she is not equal to the King Edwards of the British navy, and it is doubtful if she is even a match for the French République class.

The German Naval Budget for 1905 makes provision for the laying down of two battleships of this class, and one large and three small cruisers. These two battleships will be the last two of the Commas class, Q and R, N, O and P having been already commenced. I omitted to mention last month that O is in hand at the Vulcan Yard, Stettin. In the budget for 1905, there is a third instalment for N and a second for O and P, and final provision is made for the Preussen and Hessen. A second instalment is also provided for the large cruiser C, which is building in the Weser yards, Bremen, and for the small cruisers N. Ersatz Alexandrine, and Ersatz Meteor. These three small vessels are to be finished by 1906. The Bremen, name ship of the class, has been completed and passed into service on the Central American Station. On her trials she attained a speed of 23.29 knots, with an I. H. P. of 12,000, her contract figures in each case being 22 and 10,000 respectively. The Hamburg on trial also gave excellent results, making 23.15 knots, with 11,582 horsepower at forced draft, and 20.4 knots with 7241 horsepower at natural draft.

Progress with the battleships of the Braunschweig class has been well maintained during the last two months, and it is now considered most probable that the two first vessels of the class, the Braunschweig and the Elsass, will be under the pennant by the end of this year. The Hessen and Preussen, launched in August and October of last year, respectively, are being pushed forward with all convenient dispatch, while the Lothringen, which took the water in May last, is in an advanced stage.—*Page's Magazine.*

The growth of the German navy has been the subject of comment in these notes on several occasions; but it has not previously been remarked to any great extent that with the increase of the material the personnel has not been allowed to lag behind. In the five years between 1899 and 1904 the additions to the personnel of the fleet have been remarkable. In 1899 there were 24,580 of all ranks; to-day there are 35,352. The increase are most notable in the commissioned and petty officers' numbers, although there has been a marked increase all round. The numbers in the various branches at the present time are: Ship's officers, 1250; engineer officers, 223; surgeons, 197; paymasters, 164; warrant officers, 1587; petty officers,

7111, and seamen, 24,820. By 1917, at which date the naval programme of 1900 should be completed, it is anticipated that there will be 60,000 men serving in the navy.—*Page's Weekly.*

It has been decided to add yet another inch to the battery of the new N class German battleships, the 6.7 guns of which will now be protected by 8 inches of Krupp armor. Another point of interest is that it has been decided to have no cylindrical boilers at all in the ships of this class, but Thornycroft water-tube generators only.—*Engineer.*

The organization of the German active fleet has recently been the subject of an imperial order, by which various changes both in command and composition are made. The position of chief of the first squadron is to be distinct from that of chief of the whole fleet and subservient to it, but the flagship of commander-in-chief of the active fleet will belong to the first squadron in all matters of discipline, training and command. The first squadron now consists of four Wittelsbachs and two Kaisers, and the second squadron of two Kaisers, two Braunschweigs, and the old vessels Wörth and Weissenburg. By next year these two last will, no doubt, be replaced by the Preussen and Hessen, but it is remarkable that the order contains no mention of the Schwaben, the last of the Wittelsbachs, now ready for service. It is to be presumed that she will be attached to the first division to bring that squadron's strength up to six battleships. The reconstruction of the Wörth and Weissenburg has not been so thorough as was originally intended, and despite re-armament and the removal of a large amount of superfluous woodwork, which has been replaced by more modern protection, they are still far from being equal, as fighting machines, to the Royal Sovereigns of the British navy, to which class they approximate in point of date.

Germany, the first to adopt the combined cylindrical water-tube boiler, is also the first to abandon it. In the new Commas class, to which reference was made in the last instalment of these notes, the Thornycroft type of boiler is to be used, and no more cylindrical boilers are to be installed in German vessels. This is instructive, in view of the fact that in the British navy all the new vessels now under construction are to be fitted with various combinations in which there is generally 20 per cent cylindrical boiler, and that both the United States and Italy have experimented with combinations. France, on the other hand, has never departed from the water-tube boiler since first she introduced them.—*Page's Weekly.*

Count Reventhlow, in an article in *Ueberall*, has been speaking very plainly about the design of the German battleships of the N or Commas class. Neither the ships building (N, O, and P), nor those for which the new estimates make provision (Q and R), satisfy modern conditions. He complains that the 6.7-inch guns of the Braunschweigs are of inferior caliber to those of the ships of the same age in other navies, and that the secondary armament of almost any foreign warship built during the last four years can pierce the armor of the Braunschweigs. He would have the two new vessels of larger displacement, carrying thicker armor and heavier armament. The armor should be from 8 to 8½ inches thick, and it is in the secondary armament that the increase in metal could be arranged for. The cruising speed of the vessels he would have 17 knots with bunker capacity for at least 2000 tons of coal, and in addition some hundreds of tons of liquid fuel should be carried. The displacement might very well be 15,000 tons. Although all this would divide the newer vessels into two classes, Count Reventhlow considers that the increase in fighting power would outweigh considerations of homogeneity.

The "new naval programme" has yet to be announced, and matters seem to point to the probability of its presentation to the Reichstag being indefinitely postponed. The deplorable state of the finances of the country, however, render it doubtful if any such measure would meet with support

at the present juncture, and for the present the expansion of the fleet will not be insisted on.—*Page's Weekly.*

The use of oil for fuel is being constantly extended in the German navy. We have already pointed out that several torpedo-boats have been fitted to burn oil. Now the new battleships of the Braunschweig type have been similarly arranged and will carry a supply of 200 tons of oil in their double bottoms. The Hohenzöllern is also provided with oil burners. The ports of Kiel and Wilhelmshaven, as well as the coaling stations of Holtenau and Brunsbüttel, have great oil tanks. A special transport for supplying oil to ships either at sea or in port has been finished and another is about to be built.—*Le Yacht.*

Ueberall publishes, says *The Times,* a belated account of the German naval manœuvers from official sources, but complains of the omission in the official report of interesting and, indeed, necessary details. A Blue force, consisting of the battleships Wittelsbach, Wettin, Zahringen, Mecklenburg, Kaiser Wilhelm der Grosse, and Schwaben, under the command of Rear-Admiral Breusing; of the cruisers Prinz Adalbert, Nymphe, Hamburg, Arkona, and Pelikan, under the command of Rear-Admiral Zeye; and of a torpedo-boat flotilla and the two transports Karola and Olga, has left Kiel for the North Sea—Baltic Canal when it receives intelligence of the approach to the German coast of a Yellow force, consisting of the coast defence ships Hildebrand, Beowulf, Odin, and Frithiof (which for the time were considered as the equals of the opposing ships of the Wittelsbach class); of the battleships Kaiser Karl der Grosse and Kaiser Friedrich III, these two and the four coast defence ships being under the command of Vice-Admiral Fritze; of the cruisers Prinz Heinrich, Friedrich Karl, Ariadne, Medusa, Niobe, Amazone, and Frauenlob, under the command of Rear-Admiral Schmidt; and of 11 seagoing torpedo-boats. The Blue force telegraphed to a squadron supposed to be cruising on the coast of Norway to join it, but this supposed squadron does not affect the issue in any way. On September 8, at 3 a. m., the Yellow force was at Borkum Island, and the Blue force at the mouth of the Elbe, whence it had hastened to prevent the entrance from being mined (the precise position at the mouth is not reported). The main Blue force (the Schwaben and Wettin, supposed to be damaged, were to follow three hours later) moved out to meet the Yellow force between 7 and 8 a. m. The official report does not state where the main force would await the coming of the two battleships, or whether the position of the Yellow force was ascertained by cruisers or from signal stations. At outbreak of hostilities on September 8 the Yellow cruisers advanced at full speed to the mouth of the Elbe and met the Blue cruisers, but details of the meeting and the ensuing fight between them are not given. It is simply stated that the Blue cruisers Prinz Adalbert and Nymphe were considered damaged, and that afterwards, on the approach of the Yellow cruiser Prinz Heinrich and torpedo flotilla, they were put out of action. The coming of the two transports is specially reported, but in what way they could have affected the issue remains a mystery. The Blue battleships then appeared on the scene and the Yellow cruisers withdrew. There should then have followed a meeting with the Yellow battleships, but a fog intervened, and the Blue commander thought it wiser to go back to the mouth of the Elbe. Arrived there, he heard firing astern—that is, to the west of him—and turned his ships round. The fog lifted and revealed the Wettin and Schwaben chased by the whole Yellow fleet. The two vessels had passed the Blue fleet in the fog at a distance of 550 yards without observing it or being observed, and had found the Yellow fleet. The two ships were considered damaged by the Yellow fire, but in a condition to join their own side in giving battle. This battle was, however, prevented by the coming on of a thick fog, and for fear of collisions the German Emperor, who was present, signalled by wireless telegraphy the end of the naval manœuvers.

In the combined naval and military manœuvers which followed a few days later, the ships of the fleet embarked at the mouth of the Trave 3600 men, 170 horses, and 12 guns, with their carriages, limbers, and ammunition wagons, in three hours. These troops were disembarked on September 13 at Wehlenberger Wik, where the water close inshore was shallow. The warships remained about six miles out. The men disembarked into lighters, which were towed toward the beach, but when some distance away the men transhipped into steam pinnaces, which ran inshore until they touched bottom; this was still about 170 yards from the beach. Ship's boats of all kinds were sent to take them in nearer, but finally the men had to wade; the horses, ridden barebacked, also waded ashore. The guns with carriages and wagons were transferred from lighters to rafts, which were pulled ashore by men and horses. The ships came to anchor at 8 a. m.; at 8.30 a landing corps of marines had got ashore; at 10 a. m. the infantry were all landed, and by 11 a. m. the artillery; so that the disembarkation took the same time as the embarkation. This was the first time in German manœuvers that troops other than marines and sailors have embarked and disembarked.—*United Service Gazette.*

THE NEW GUNNERY SCHOOL AT SONDERBURG.—The works at Sonderburg, on the Alsen Sound, which is to be the new station for the gunnery training-ships and school, have been taken in hand. For the station a stretch of the shore, 1100 yards in length, has been secured; on the sea face of this a stone jetty 800 yards long will be constructed, with five landing stages fitted with the necessary bollards, etc. The mooring places of the ships and boats will be connected with the shore by long gangways. In rear of the mole it is proposed to construct three terraces, on the center one of which will be erected the necessary school buildings to accommodate 100 cadets; later on barracks for the men will be built on the upper terrace, but for the present only the necessary temporary quarters will be put up, although there is no doubt that there will be before long a large development of this new station. As soon as possible the gunnery-ships, now lying at Kiel, will be transferred to Sonderburg, only returning to Kiel for the necessary repairs. The naval authorities have been in communication with the Muncipal Council of Sonderburg, where the necessary accommodation for the married officers and warrant officers will be found, a new road being constructed to connect the town with the station.

PRIZE FIRING AND MARKSMANSHIP IN THE NAVY. A NEW KAISER CHALLENGE CUP.—The Kaiser has given a new proof of his continuous interest in the shooting of the fleet by offering a second silver cup for competition in heavy gun target practice to the active fleet. Ten years ago His Majesty presented his first challenge cup, which is competed for each year by the ships of the first squadron. In 1894 and 1895 the Sachsen held it; in 1896 it went to the Wörth; in 1897 to the König Wilhelm; in 1898 to the Weissenburg, and in 1899 to the Kurfürst Friedrich Wilhelm. In 1900 and 1901 it was not competed for, but in 1902 it was won by the Kaiser Friedrich III, and last year by the Wittelsbach. The new trophy is to be competed for by the ships of the newly constituted second squadron of the active fleet and the two armored cruisers of the cruiser division, while the first cup remains as before with the first squadron. Three years ago the Kaiser presented a gold challenge cup to be competed for by the Cruiser Squadron; this was won in 1901 by the Fürst Bismarck; in 1902 by the Thetis, and again in 1903 by the Fürst Bismarck.

It was only last year that the German Admiralty, with the view of increasing the standard of marksmanship in the fleet, and at the same time providing a reserve of well-trained seamen-gunners, inaugurated a system of increased pay to seamen, who, after receiving a special training in gunnery, re-engage at the end of their three years' compulsory service for a similar period. These men will be known as *Schützenkapitulanten*, will serve on board the vessels of the active fleet, and will receive 200 marks

(£10) in addition to the pay ordinarily received by seamen who re-engage (*Kapitulanten*). This bonus will be treated as deferred pay, and handed to the men when they obtain their discharge. The *Schützenkapitulanten* will be allowed three months' leave on full pay, which they may take either at the beginning or end of their term of service. Men who show special aptitude will be given facilities for continuing their career in the navy as petty officers.—*Marine Rundschau* and *Neue Preussische Kreus-Zeitung*. Translation from the *United Service Institution*.

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Lord Nelson	16,500	Glasgow (Beardmore).	Ordered.
Agamemnon	16,500	Jarrow (Palmer).	Ordered.
Africa	16,350	Chatham	Building.
Britannia	16,350	Portsmouth.	Launched Dec. 10, 1904.
Hibernia	16,350	Devonport.	Building.
Hindostan	16,350	Clydebank.	Launched Dec. 18, 1903.
New Zealand	16,350	Portsmouth.	" Feb. 4, 1904.
Commonwealth	16,350	Glasgow.	Under trial.
Dominion	16,350	London.	
King Edward VII	16,350	Devonport.	"
Queen	15,000	"	"
Armored Cruisers.			
Minotaur	14,600	Devonport.	Ordered.
Shannon	14,600	Chatham.	"
Defence	14,600	Portsmouth.	"
Orion	14,600	....	....
Duke of Edinburgh	13,500	Pembroke.	Launched June 14, 1904.
Black Prince	13,500	Blackwall.	" Nov. 8, 1904.
Warrior	13,500	Pembroke.	Building.
Cochrane	13,500	Glasgow.	Ordered.
Natal	13,500	Barrow.	"
Achilles	13,500	Newcastle.	"
Hampshire	10,700	Elswick.	Launched Sept. 24, 1903.
Devonshire	10,700	Chatham.	" April 30, 1904.
Roxburgh	10,700	Glasgow.	" Jan. 19, 1901.
Antrim	10,700	Clydebank.	" Oct. 8, 1903.
Argyll	10,700	Greenock.	" March 3, 1905.
Carnarvon	10,700	Glasgow.	" Oct. 7, 1903.
Cornwall	9,800	Pembroke.	Under trial.
Lancaster	9,800	Elswick.	"
Protected Cruisers.			
Encounter	5,880	Devonport.	Launched June, 1902.
Topaz	3,000	Birkenhead (Laird).	Under trial.
Amethyst	3,000	Elswick (Armstrong).	" "
Diamond	3,000	Birkenhead (Laird).	Launched Jan. 6, 1904.
Sapphire	3,000	Jarrow (Palmer)	" March 17, 1904.
Gunboats.			
Cadmus	1,096	Sheerness.	Launched April 29, 1903.
Clio	1,096	"	Under trial.
Scouts.			
Adventure	2,750	Elswick.	Launched Sept. 9, 1904.
Forward	2,545	Fairfield.	" Aug. 27, 1904.
Pathfinder	2,610	Birkenhead.	" July 16, 1904.
Sentinel	2,900	Vickers.	" April 19, 1904.
Skirmisher	2,900	"	Building.
Foresight	2,545	Fairfield.	Launched Oct. 8, 1904.
Attentive	2,750	Elswick.	Building.
Patrol	2,610	Birkenhead.	Launched Oct. 12, 1904.

The orders for the two battleships included in the navy programme of 1904-5 have been placed. One of these is to be built at the new works at Dalmuir-on-Clyde of Messrs. William Beardmore and Co., Limited, fully described in last week's *Engineering*, and the other at the works of Palmer's Shipbuilding and Iron Company, Limited, Jarrow-on-Tyne. These battleships, the first designed by Mr. Philip Watts since he was appointed Director of Naval Construction and Assistant Controller, mark a large step in advance, especially in respect of gun-power and of armor protection. For many years it has been the invariable practice to fit four 12-inch guns into our battleships as a primary armament, and, up till the design of the King Edward VII by Sir William White, the secondary armament was exclusively of 6-inch quick-firers. But it had long been urged that, in view of the greater resistance of armor to penetration, these quick-firers would be ineffective in a fleet action fought at about 3000 yards' range. In the King Edward VII class four 9.2-inch guns were substituted for a corresponding number of 6-inch weapons; while this was a useful addition to fighting power, it was still considered by some that the remaining 6-inch guns were inadequate. Mr. Watts has now discarded them, and the armament of this new Lord Nelson class includes four 12-inch and ten 9.2-inch guns. At the same time the length of the guns has been increased—the former from 40 to 45 calibers, and the latter from 45 to 50 calibers. So that, separately, as well as collectively, the ordnance of the new ships has much greater fighting power than that of the preceding ships. The 9.2-inch guns will be mounted, eight of them in pairs, within gun-houses over the upper deck, while the two remaining weapons will occupy central positions on each broadside. It is important to note that thus none of the guns will be placed at a lower level than the upper deck, while the machine-guns, numbering fifteen 12-pounders, twenty-three 3-pounders, and two Maxims, will be mounted on the central battery behind, and at a higher level than, the main guns, so that they will command the whole sea area within torpedo range of the battleships. As regards armor, the more vital parts of the ship will be protected by broadside armor of greater thickness than has yet been adopted since the latest quality of carburized steel was introduced, 12-inch steel being more extensively adopted than hitherto. The side armor extends from 5 feet below the water-line to the upper deck, which level is also armored in the vicinity of the guns, and this side protection extends, although of reduced thickness, forward to the ram. There will be five submerged torpedo-firing tubes. The Palmer ship will be fitted with Babcock and Wilcox boilers, and the Beardmore ship with Yarrow boilers. The machinery for this latter ship is to be constructed by Messrs. Hawthorn, Leslie and Co., Newcastle-on-Tyne, under sub-contract with the builders. The engines are to be of 16,750 indicated horsepower, each engine having a high-pressure cylinder of 32¾ inches, an intermediate of 52¾ inches, and two low-pressure cylinders of 60 inches in diameter, with a stroke of 48 inches. Full power is to be developed with the engines running at 120 revolutions, and taking steam at 250 lb. pressure; but the boilers will work at 275 lb. There will be fifteen boilers in each ship, the total weight of machinery in the Beardmore ship being 1545 tons, and in the Palmer ship 1560 tons. The vessels are rather shorter than the King Edward class, being 410 feet, as compared with 425 feet, but they have a beam of 79.6 feet, as compared with 78 feet, and their depth is 43 feet 1½ inches, as against 42 feet 11 inches. The hull is of slightly less weight, and at the same time the cost is less. The weight of the armor of the new ships is barely as great as in the King Edward VII class, but the thickness is more directly proportioned to the vital nature of the area to be protected, and the protection is therefore more effective throughout. There is a slight saving in weight in the machinery, since no cylindrical boilers are being fitted. The whole of the economy in weight from the various items, as well as the increase in displacement, is utilized for the increase in gun power and ammunition, the result being that greater offen-

sive quality has been attained in this ship with a very slight increase in total displacement, the new vessels being 16,500 tons, while the earlier ships were 16,350 tons.—*Engineer.*

A number of engineering firms throughout the country have been invited by the admiralty to send in tenders for the construction of machinery for the three armored cruisers to be built at the dockyards under this year's naval programme. The vessels—which will be built at Devonport, Chatham, and Portsmouth—are to be known as the Minotaur class. In their design they mark an important advance on the Duke of Edinburgh type, the first designed for the navy by Mr. Watts as Director of Naval Construction. They will be 10 feet longer, 490 feet in all, approaching again the 500 feet attained in the Powerful and Drake classes. This is the maximum reached by warships, as length is regarded always as a necessary evil, so that whenever the 500 feet is approached an effort is put forth to revert to shorter vessels, because they can be more easily manœuvered in harbors or channels of restricted area. The greater length, too, adds to the size of the target. But, apart altogether from the injunction laid upon the naval architect to carry increasing loads on lessening draft, necessitating, as it does, increased length of beam, there is the fact that length is a factor conducive to speed. For these reasons our warships, like our high-speed merchant vessels, have been steadily increasing in length. The new ships differ in the strength of their armament. They will carry eight 9.2-inch guns instead of six, as in the Duke of Edinburgh class; a corresponding reduction being made in the secondary battery. All of the boilers, too, will be of the water-tube type, reverting to admiralty practice, and conforming with the later view of the boiler committee. The engines will be of the four-cylinder, triple-expansion type, and a speed of 22½ knots is anticipated.

Changes of an important character are being made in the armament and fitting of the new cruiser Cornwall, which recently arrived at Devonport from Pembroke Dock, where she was built. The mountings of the twin 6-inch guns have been hoisted out for re-adjusting so as to ensure the axes of the guns being parallel at all elevations. A similar alteration had to be made in the Essex, a sister ship. The cradles of the other 6-inch guns will be fitted with extra sleeve pieces to give these more steadiness, it having been found that the length of these guns caused a tendency to spring when fired. The cruiser's funnels are also to be shortened 15 feet and the masts lengthened.—*United Service Gazette.*

The Fairfield Shipbuilding and Enginering Company (Limited), Govan, launched on Saturday the "fleet scout" Forward, which they have built for the admiralty. She is the first of two vessels the firm has on hand for this new class. These vessels are not expected to enter the fighting line in time of war, but will serve as attendants to vessels of the fleet, and search out and convey information as to strength and position of the enemy. Lightness and speed are essentials. The Forward is 384 feet long over all, and 39 feet 2 inches wide, while her draft of water in normal load condition will be about 14 feet. Her displacement will be 2850 tons, and her speed 25 knots, with machinery developing 16,500 I. H. P. Her bunkers are capable of stowing away coal with which she may steam a total distance of about 6000 knots at about 12 knots speed, a distance just double that required by the terms of the admiralty inquiry. She will be lightly armed with ten 12-pounder guns and eight 3-pounders, together with two 18-inch deck torpedo-tubes. Protection is afforded to the engines and boilers by a belt of 2-inch Krupp non-cemented armor extending from 30 inches below the water-line to the upper deck and across the vessel at each end of the machinery spaces, and by the upper deck of ¾-inch high tensile steel. Further protection is given to the boilers by the coal, which is arranged in side and cross bunkers surrounding the boiler rooms and reaching to the upper deck level. The magazines

are protected by an armored deck extending well below the water-line. A governing feature of the design is the great weight of material devoted to strengthening the main structure of the hull, and the care taken to ensure that the parts contributing to longitudinal strength should run continuously without loss of strength at the butts and without abrupt changes of scantling. High tensile steel has been largely used, and the Forward will be one of the strongest war vessels that has ever been constructed. As regards appearance and accommodation, she has been designed with a full forecastle forward and a sunk poop aft, the former affording an elevated gun platform and ensuring dryness, while the latter, which is a distinctive feature of the Fairfield design, gives roomy apartments for the accommodation of the officers. On the forecastle are three of the 12-pounder guns and a circular conning-tower of 3 inches. Krupp non-cemented steel with navigating bridge, steering shelter, searchlight platform, chart-room, and captain's watch cabin above. Aft above the poop is another light bridge, and on each bridge are placed two of the 3-pounder guns. In the waist of the ship are four 12-pounder and four 3-pounder guns and the two torpedo tubes, and on the poop deck are the remaining three 12-pounders. The total complement is 290 officers and men, including about 150 stokers and 50 seamen. The propelling machinery consists of two sets of triple-expansion engines in two watertight compartments, each set having four inverted cylinders working on four cranks, balanced on the Yarrow, Soblick, and Tweedy system. Steam will be supplied by an installation of 12 water-tube boilers of the latest small tube type, designed for a working pressure of 260 lbs. The Forward is to have three funnels, and a single mast with light signalling yard and wireless telegraphy pole.—*United Service Gazette.*

Special interest attaches to the Black Prince, launched on November 8 from the yard of the Thames Ironworks and Shipbuilding Co., Ltd., and her sister the Duke of Edinburgh, as these are the first ships designed by Mr. Philip Watts.

Below are particulars of the Black Prince compared with the French Rénan and the U. S. A. California, which are of practically the same displacement, also with the British Drake class. It is interesting to note that while we have decreased in size the Americans have made a corresponding increase.

Owing to the different systems employed in mounting the big guns, comparisons of the total armaments are a trifle misleading. The broadsides are:

B. Prince.	Drake.	Rénan.	California.	Washington.
Four 9.2-in.	Two 9.2-in.	Two 9.4-in.	Four 8-in.	Four 10-in.
Five 6-in.	Eight 6-in.	Six 6-in.	Seven 6-in.	Eight 6-in.

So that the Washington is much the more serious opponent on paper. In actual practice the Black Prince has a reserve of guns, as the plan indicates, though there is reason to doubt whether this has all the value that was assigned to it a year ago. The Far East fighting seems to indicate that very few guns will be disabled in battle. Should this prove to be a general truth, then the Black Prince class will always be in the position of having two useless guns. Since, however, each of the four big guns in this type is mounted singly, the "survival chances" of each are considerably greater than those of the usual twin turret armed ship. With single turrets, also, a greater rate of fire is to be maintained, so that, despite the two idle guns, the four single pieces undoubtedly represent more fire than would the same guns in a pair of turrets.

The Black Prince and her sister the Duke of Edinburgh are usually described as the first completely belted British ships of modern times. This, however, is not a feature of very much importance because they only carry 3-inch aft, and double skins, and so forth, give most of our recent ships about 2-inch. The one thickness is probably of little more use than

Name	Black Prince.	Drake.	Rénan.	California.	Washington.
Nationality	British.	British.	French.	U. S. A.	U. S. A.
Displacement, tons	13,500	14,100	13,500	13,400	14,500
Length, ft.	480	500	515	502	502
Beam, ft.	73½	71	72	70	73
Draught (mean), ft.	27½	26	27	26½	26½
Main armament	Six 9.2-in.	Two 9.2-in.	Two 9.4-in.	Four 8-in.	Four 10-in.
Secondary armament	Ten 6-in.	Sixteen 6-in.	Twelve 6.4-in.	Fourteen 6-in.	Sixteen 6-in.
Tertiary armament	Twenty 3-pdrs. Eight pom-poms	Ten 12-pdrs. Three 3-pdrs. Two Maxims.	Twenty-two 3-pdrs. Two 1-pdrs.	Eighteen 12-pdrs. Twelve 3-pdrs. Sixteen smaller	Twenty-three 12-pdrs. Twelve smaller
Submerged tubes	Three	Two	Two	Four	Four
Belt	6-in.—3-in.	6-in.—3-in.	6-in.—4-in.	6-in.—3½-in.	5-in.—3-in.
Armor deck	¾-in.	4-in.	2¼-in.	4-in.	3-in.
Side above belt	6-in.	6-in.	5-in.	5-in.	5-in.
On big guns	6-in.	5-in.—6-in.	6-in.—8-in.	6-in.	9-in.—5-in.
On secondary guns	6-in.	6-in.	5-in.—6-in.	5-in.	5-in.
Horsepower	23,500	30,000	33,000	23,000	?
Designed speed, knots	22	23	23.5	22	22
Boilers	Babcock & cylindrical	Belleville	Niclausse	Babcock	Babcock
Coal (normal), tons	1000	1250	1400	900	900
Coal (maximum), tons	2000	2500	2300	2000	2000
Weight of armor, tons	....	2700	3400	2219	....
Weight of machinery, &c., tons	2220	2800	....	2150	....

the other under modern battle conditions. A more real advantage is that the usual 6-inch amidships belt is continued to the bow at 4-inch; 4-inch is the thinnest armor for which the Krupp process can advantageously be used, so that there is more than 2-inch value for the 2-inch difference between the bows of the Black Prince and the Drake.

Against this, however, is to be set the fact that the vessels of the Black Prince class are practically without armor decks. A skin deck of two thicknesses exists, but its stopping power is probably insignificant. Viewed in connection with the very great advances recently made in capped projectiles, this virtual abandonment of the armor deck's extra resistance does not please the average naval officer, though possibly the greatly increased offensive power of the Black Prince may be counted by some as a considerable makeweight, offence being from some points of view the best defence that can exist. This, however, is still an obscure point, since it is involved by the fact that the first shot or so of the enemy may do enough damage to render the originally powerful attack equal or inferior to his own, while he himself, being better defended, suffers nothing from that demoralization which hits are almost bound to produce to a greater or less extent.

The Black Prince, like the Duke of Edinburgh, will be among the last of ships with the 6-inch guns—abolished for their later sisters. These 6-inch will be 50 calibers long, and, therefore, considerably more powerful than previous guns of this size, but whether they will ever fire in battle is another matter. There is little to indicate at present that ranges at which the 6-inch gun will be any good will obtain.

It is worthy of note that there is no ahead fire for the forward 6-inch guns—a good thing. Sponsons and recessed ports forward are pretty on paper; in fact, they merely serve to check speed and make the ships wet.

The Black Prince carries no 12-pounders. Presumably she relies upon her 6-inch guns to check torpedo attack, for 3-pounders are useless for this. It may be added that 12-pounders appear to be little more useful.

In speed the Black Prince is below the Drake class, which reach 24 knots with a very economical coal expenditure. This speed reduction is viewed with disfavor, despite the theory that a certain 22 knots is better than a problematical 23. The Drakes do a certain 24, and the Black Prince class, it is hoped, will also exceed the contract speed by a knot. The steam generators to be fitted are of the Babcock and Wilcox type, of the latest improved pattern.

To sum up, the Black Prince type is better armed than the Drake class by at least 33 per cent. In defence it is about 20 per cent less efficient, but it is also smaller than the Drake type. In speed and coal endurance there is an inferiority of approximately 8 per cent. The armament gain is so great that it more than balances any loss, and the advance is certainly commensurate with the times.—*Engineer.*

The Adventure, a ship of the new "fleet scout" class, built for the navy by Messrs. W. G. Armstrong, Whitworth and Co., at Elswick, was launched on the 9th of September. The naming ceremony was performed by Miss Barry, daughter of Captain Barry, Director of Naval Ordnance. The Adventure is 374 feet long, with 38 feet 3-inch beam, and has a displacement of 2850 tons. She will be armed with ten 12-pounders and eight 3-pounder quick-firing guns and two torpedo-tubes. Her speed is to be twenty-five knots an hour. Sir Andrew Noble stated that the new type of vessel had proved of very great utility in the Russo-Japanese War. He hoped shortly to launch a sister ship, the Attentive.—*United Service Gazette.*

The admiralty, it is understood, will within the next three or four weeks invite tenders for the construction of the fourteen torpedo-boat destroyers to be built under the year's programme. There appears still to be some doubt as to the type of vessel to be adopted. Many officers strongly sup-

port the more recent vessels which have in sea-going trim a speed of 25½ knots; while others look askance at the fact that even in fair weather and in emergency there is no new torpedo craft of a greater speed. For torpedo work speed is everything, and thus many contend that 28 knots ought to be possible. The admiralty would willingly accept this higher rate if it could be got along with the other conditions, and without a great increase in cost. In the circumstances, it is only right that in the new contracts terms of load, etc., should be specified, with a minimum speed of say 25½ knots: and that a premium should be paid for each extra quarter-mile per hour realized on trial. When penalties are exacted for deficiencies in speed, it does not seem unreasonable to have premiums for higher speed. If these premiums were of an encouraging amount, especially for large additions, there is no doubt that the building firms would exert all their ingenuity to afford the necessary improvement. Such rewards would be an incentive to advance in steam propulsion.—*United Service Gazette.*

THE INDIAN TROOPSHIP DUFFERIN.—It is long since the British Government departed from the practice of building ships for the transport of troops from one part of the Empire to another—a fact which is to be regretted, as these were most admirable schools for the training of engineers, since the conditions required the running of the machinery for long periods of time, involving continuous vigilance and strain on the mechanism, which brought out the better qualities of the personnel. The Indian Government, however, have found it more profitable to maintain their own ships, but for many years the Royal Indian Marine have taken complete charge; and there is, therefore, no educational advantage so far as the British navy is concerned. The reason, of course, for the maintenance of the fleet is found in the fact that during the season there are transported from India 12,000 officers and men, in addition to their wives and families; while the ships are further utilized, not only for service on the coast of India, but in connection with the many expeditions which are organized by the government. For many years Sir Edward Reed, K. C. B., has acted as naval architect for the India Office, and he himself readily admits that, in the arrangement of the many important details which ensure the success of the vessels, he has had valuable help from the officers of the Royal Indian Marine.

In the design of these Indian troopships there has been steady progress, and in connection with the launch on September 14 of the latest and largest vessel yet constructed for the purpose—the Dufferin—floated from the works, at Barrow-in-Furness, of Messrs. Vickers, Sons, and Maxim, Limited, evidence is afforded of this advance. Taking the Serapis, built about 1867, as the starting point of comparison, and the Warren Hastings, built at Barrow thirteen years ago, as the intermediate ship, we find that steady progress has been made. This is specially notable in connection with the speed. The Serapis was a vessel of only 14 knots, the Warren Hastings made 16.8 on trial, and the new vessel is designed to steam at 18½ knots. In size there has been also a considerable increase, as the Serapis was only 360 feet long between perpendiculars, while the Warren Hastings was 337 feet, and the new ship is 437 feet long. In displacement tonnage the advance has been progressive from 6211 tons to 7340 tons. As indicative of the advance in the efficiency of engines and boilers we note that the horsepower in the case of the Dufferin has only increased 30 per cent, while the displacement has gone up over 50 per cent, and the speed is over 2 knots greater. The greater speed will be very advantageous in the event of the employment of the vessels as armed cruisers; while owing to the higher steam pressure and the greater engine economy, the consumption of fuel is reduced for the higher power of the later ship, while a reduction has been made in the crew, owing to the important mechanical equipment on board. There is, too, a very striking advance in the armament.

Indeed, the Dufferin is the most powerfully-gunned ship of the class. Instead of two 20-pounder guns she has eight 4.7-inch weapons, firing 45-lb. shot, and instead of one howitzer, she carries eight 3-pounder rapid-firing guns. It would be easy, also, to demonstrate the increased efficiency in respect to the handling of stores, and also in the comfort of the habitable quarters. In regard to cost, the later ships are cheaper than the earlier vessels, notwithstanding the very considerable increase of size, accommodation, comfort, and speed.

The appended table shows the main features of the three vessels, the one the Serapis, of 1867, the second the Warren Hastings, of 1885, and the third the Dufferin, just launched.

COMPARISON OF OLD AND NEW INDIAN TROOPSHIPS.

	Serapis, &c.	Warren Hastings.	Dufferin.
Length between perpendiculars	360 ft.	337 ft.	437 ft.
Breadth, extreme	49 ft. 1½ in.	49 ft. 2½ in.	52 ft. 6 in.
Draught forwd.	16 " 4 "	....	18 ft.
Draught aft.	20 " 7 "	....	20 "
Draught mean.	18 " 5⅝ "	17 ft. 4½ in.	19 "
Displacement in tons	6211	4807	7340
Area of mid-section in sq. feet	783.77	780	800
Horse power nominal	700	....	....
Horse power indicated	3945	7302	9400
Trial speed in knots	14	16.82	18½
Water, tons	147	90	200
Crew (Officers and men), number	251	182	260
Troops, officers, ladies and children, number	1243	1165	1200
Cables, size	2⅛ in.	2⅛ in.	2⅝ in.
Anchors, bower	4 of 75 cwt.	4 of 60 cwt.	3 of 74 cwt.
Armament	Two 20-pdr. Armstrong One 24-pdr. Howitzer.	Six 4.7-in. guns Six 3-pdr. guns	Eight 4.7-in. guns Eight 3-pdr. guns.
Coal, in tons	1180	674	1200

The vessel differs little in construction and internal arrangements from the first-class modern merchant ship; but a closer examination reveals many important departures in detail to suit her for her special mission. She is designed with due consideration to her adoption as an armed cruiser, and thus will be provided with eight 4.7-inch quick-firing guns, and eight 3-pounder quick-firers, the largest size of searchlight projector, large magazines and armory under the water-line, and other similar auxiliaries. Great care has been taken to insure the vessel against sinking, should she, unfortunately, be in danger. There is a cellular double bottom, within which there may be carried 800 tons of fresh water, and there are distillers for making 35 tons per day. She is built of strong scantling, with four complete decks, and a boat or promenade-deck amidships, extending about half the length of the vessel. Internally there are a large number of water-tight compartments, and for the first time in a troopship, there has been introduced the Stone-Lloyd system of control for water-tight bulkhead doors. By this system all the doors can be closed by hydraulic gear from the captain's bridge, though at the same time, any one door may be closed from several positions, while automatic arrangements are provided so that the flow of water into any one compartment would at once close the door of communication from such compartment to others. At the same time a bell is rung at the door to give sufficient warning to any one living in the compartment at the time. Owing to the fact that the vessel will have to pass through the Red Sea, teak has been used throughout for decks, etc., and for the same reason ventilation has had primary consideration.

The Dufferin has accommodation for about 100 first and second-class passengers, 1100 European troops, as well as for all the officers, engineers, crew, firemen, officers' servants, soldiers' wives and children, making a total complement of about 1520 in all. On the boat-deck large teak deck-houses are built to accommodate the captain and ship's officers. On the spar-deck are arranged the entrances to first and second-class passenger accommodation and saloons, and to troops' quarters; a large nnd handsome smoking-room and music-saloon and state-rooms are also built on this deck. State-rooms are built on the main deck for the first and second-class passengers and officers, with dining-saloons, galleys, pantries, and bakeries. The usual lavatories, bath-rooms, etc., are provided, having hot and cold water supply. The firemen and crew are berthed on this deck forward. The troops' and women and children's quarters are placed on the troop and orlop-decks; and these places are fitted up complete with hospitals, wash-places, bath-rooms, water closets, etc., a cot-lift also being provided to enable any of the sick to be raised to the spar-deck. Magazines and armory, store and provision-rooms, refrigeration-room, fresh-water tanks, etc., are built on the orlop-deck and in holds.

The sanitary arrangements have been specially studied, and are of the most efficient description, a large number of electric ventilating-fans being fitted in addition to the natural ventilation provided. In the 'tween decks large ventilating windows are fitted. A system of steam and electric heating is fitted up throughout all living spaces. The derricks and gear for working the cargo and stores, also the capstans and boat-winch, are all fitted up with hydraulic power. A powerful steam-windlass is fitted on the spar-deck forward for working the anchors, which are of the stockless type. The steam steering-gear is placed on the spar-deck amidships, with chains led aft to the screw gear on the poop-deck. The steam gear is controlled by telemotor on the bridge-deck. Helm-signals are fitted on the main mast to indicate the position of the rudder. A large number of boats, including two steam cutters, are carried on the boat-deck; the life-boats are built of steel, and are fitted with patent davits, and the vessel is thoroughly equipped with all the usual life-saving appliances.

The vessel has a straight stem and elliptical stern, and with two pole-masts and two funnels presents a well-balanced appearance. She is to be driven at a speed of 18½ knots, by two sets of triple-expansion engines, developing 9400 indicated horsepower. There are three cylinders in each engine, the high pressure having a diameter of 30 inches, the intermediate of 47 inches, and the low pressure of 75 inches, the stroke in all cases being 48 inches. The engines are of the same type as the company adopt for high-class merchant ships, and in all cases the plant is duplicated.

The steam-distribution valves are of the piston type for the high-pressure and intermediate-pressure cylinders, and of the flat double-ported description for the low-pressure cylinders. They are actuated by valve gear of the ordinary double-eccentric link-motion type. The reversing gear is operated by steam and hydraulic engine, having steam cylinder 15 inches in diameter and 21 inches stroke, placed at the back of the engines, and worked by gear from the starting platform. The condensers are constructed of steel plates, and have a total cooling surface of 10,600 square feet; they are each supplied with circulating water by a Gwynne centrifugal pumping engine, and arranged so that either pump can circulate either condenser by means of a cross-connection.

The auxiliaries in the engine-room consist of two general service duplex pumps, to act as fire, bilge, and ballast engines; two direct-acting main feed-pumps, and one direct-acting auxiliary feed-pump; two feed-water filters; two sets of evaporators and distilling machinery, each capable of supplying 35 tons of fresh water per 24 hours; two feed-heaters; one auxiliary condenser for taking the exhaust steam from all the auxiliary engines in the ship; one fresh-water duplex pump. In the boiler-room are fitted four ash-ejectors and pumps, and four silent ash-hoists. In addi-

tion to the above, there is one large double-acting sanitary pump fitted to each set of main engines, worked in conjunction with the feed and bilge pumps from the air-pump levers. At the forward end of the engine-room on the troop-deck is a large engineers' workshop, fitted with the usual machinery, and driven by an electric motor.

The engines are supplied with steam from four double-ended boilers of the marine multitubular type, worked under heated forced draft with closed ash-pits on Howden's system. Each boiler is fitted with six of Morison's suspension furnaces, and is constructed for a working pressure of 180 lb. per square inch to Lloyd's requirements. A large auxiliary boiler of the cylindrical type with two of Morison's suspension furnaces is also fitted for supplying steam to all the auxiliary engines. Air is supplied to the furnaces by two large fans, each of which is driven by two engines. There are two funnels, 10 feet in diameter outside, and carried about 80 feet above the level of the fire-grate.—*Engineering.*

The annual long-range prize firing of the Mediterranean fleet takes place off Argostoli this month, and at the close of the competition the fleet will return to Malta, with the exception of the flagship Bulwark and the London, which are to cruise in the Adriatic. At the prize firing the ranges for battleships and cruisers are to be between 4000 and 7000 yards. Hits at the longer range will count more than those at the shorter, and, similarly, 12-inch gun hits will be held of greater value than those for 6-inch pieces. Each broadside is to be brought to bear for three minutes, and the ships are to steam 14 knots while firing. For the smaller cruisers the ranges will be 2500 to 3000 yards, but the other conditions will be the same as those governing the battleships and armored cruisers. A sensational story comes from the Mediterranean, according to which the Irresistible nearly blew up the Greek warship Basileos Georgios. The Irresistible, it appears, was at target practice off the island of Poros, the target being a small rocky eminence known as Petro-caravo. When the Basileos Georgios came into sight, firing was ordered to cease, but by some mistake a gunner in one of the 6-inch casemates failed to understand the order and discharged his piece. The missile passed across the Greek warship amidships, 2 feet from the bulwarks, and entered the water about 30 feet beyond. The Minister of Marine, Monsieur Zygomalas, was on board the Georgios, and the captain of the Irresistible immediately despatched an officer to explain that the firing of the gun was quite a mistake, and to apologize. Fortunately no damage had been done, and the Georgios was able to return to harbor. But the margin of safety would appear to have been a very narrow one.—*Army and Navy Gazette.*

The Channel fleet on its way from Invergordon to the Tyne carried out prize firing with 12-pounder guns. This was the result of an admiralty order calling on commanding officers of ships to use every endeavor to secure better results with light quick-firing guns, the effective use of which in torpedo attack is so important. The fleet recently devoted a whole day to practice, and Vice-Admiral Lord C. Beresford expressed his great satisfaction at the excellent shooting of Sergeant Hubbard, R. M. A., of the Jupiter; Petty Officer Harris and Leading Seaman Furness, of the Hannibal; Able Seaman Layton, Corporal Cole, R. M. A., and Private Mann, R. M. L. I., of the Cæsar; Sergeant Ford and Gunner Rowe, R. M. A., and Able Seaman Ford, of the Victorious; and Able Seamen Crossley and F. Cooper, of the Mars.—*United Service Gazette.*

Important exercises were carried out by the Mediterranean fleet during the run between Mitylene and Salonica. The plan of operations was as follows: "A battle fleet belonging to A is known to be steering to Salonica from Mitylene. An enemy's fortified base is situated at Port Mudros (Lennos). There is a flotilla of ten destroyers, a cruiser, and a depot-ship belonging to B. A's fleet, besides battleships, consists of two armored

cruisers, two other cruisers, and ten destroyers." This latter force had to try and keep B's ships from attacking the battleships. Owing to the ambiguous wording of the directions the operations at first miscarried, but later went well. A's force attempted to blockade B during daylight, but these ships had already left and disappeared. During the same night they reappeared, and a battle was fought between the rival destroyers. None of the battleships were put out of action, but the results were very instructive, as none of the ships had any lights of any kind showing, but they were, of course, permitted to use searchlights if necessary. The usual rules in regard to ships being put out of action were observed. The destroyers were allowed to fire torpedoes with collision heads.—*United Service Gazette.*

The admiralty issued orders for a special series of comparative trials, to be carried out this week off Portland, between three of the latest type of 25-knot torpedo-boat destroyers and three of the 30-knot destroyers. The new destroyers selected were the Usk, built by Messrs. Yarrow and Co., of Poplar, the Cherwell, built by Palmer's Shipbuilding Company, and the Arun, built by Messrs. Laird, Cammell and Co. The 30-knot destroyers selected were the Falcon, Syren and Gipsy. The trials are taking place under the superintendence of admiralty officials, and in order that they might be run under equal conditions, the whole of the vessels were undocked on the same day.—*United Service Gazette.*

The ships of the Channel fleet carried out their prize firing off the coast of Scotland during the run to Invergordon at the end of September. The weather was all that could be desired, and there was nothing to prevent the ships making good scores. The following are the rounds fired, with the actual hits made: Mars, 165 rounds fired, 86 actual hits; Magnificent, 100, 39; Majestic, 150, 60; Endymion, 173, 35; Jupiter, 182, 60; Illustrious, 160, 80; Victorious, 100, 39; Hannibal, 166, 91; Doris, 80, 15; Hermes, 81, 19; Cæsar, 187, 127. The flagship Cæsar did remarkably well, and her record will not be beaten easily.

Vice-Admiral Lord Charles Beresford has issued a "general memorandum," in which he expresses his satisfaction at the general improvement shown by the midshipmen of the Channel fleet in signalling. On October 1 last year the average throughout the fleet was 52 per cent; on the same date this year it was 82.5 per cent—a very marked improvement. The three most successful midshipmen are to be specially commended by their captains.—*United Service Gazette.*

One of the principal features of the new scheme for the training of naval cadets, as well as boys for the lower deck, is the provision of sea-going tenders to the training establishments. In the case of the Isis and Aurora, tenders to the Britannia, the innovation has been abundantly justified, especially in this respect—that it creates among the cadets an increasing interest in their work and profession. There is every reason to believe that the experiment will be equally successful with the boys. The Medusa, the tender to the two Devonport training ships, left on Monday for a cruise to Arosa Bay, and Gibraltar. Although she has already had two drafts of boys for mechanical training from the Impregnable and Lion, this is the first draft with which she has proceeded to sea beyond a cruise of a few hours' duration. The Medusa will return to Devonport on October 26. Another draft will then be in readiness, and she will again leave on November 7 for a month's cruise.—*United Service Gazette.*

Among the many promises made in the new admiralty scheme of December 16, 1902, most of which have already been redeemed, were several affecting warrant officers, who were to be promoted to executive rank. This regulation was to affect engineer warrant officers as well as chief petty officers, carpenters, etc. There were sixty gunners and boat-

swains raised to the rank of lieutenant when the new scheme came into operation, and others have been added since. A month ago a circular letter was issued by the admiralty containing the new regulations governing the promotion to commissioned rank of chief and other artificer engineers, and the retirements of lieutenants, carpenter-lieutenants, and engineer-lieutenants, promoted from the position of warrant officer of their respective branches. Another circular letter has been issued this week dealing with changes in the regulations governing the training of warrant officers of the military branch. It contains the changes involved in the revision of the seamanship examination and examination in educational subjects for gunners and boatswains. All candidates for the rank of executive warrant officer will now pass in seamanship, and must obtain 600 marks out of a total of 1000 in order to qualify. They must also pass the educational test. The maximum marks in arithmetic are to be 100, and the minimum to qualify 60. Candidates for a boatswain's warrant may in future be selected from seamen torpedo-men, as well as from seaman gunners. The qualifying course in the gunnery school will amount to ninety days for gunners, and for torpedo gunners an additional course of ten days in gunnery lectures; and diving will be required. The qualifying course in gunnery for boatswains will be fifty days. Boatswains and acting boatswains who have qualified in gunnery and torpedo will be eligible for employment on the duty of gunners or torpedo gunners in a temporary vacancy, and whilst so employed a boatswain holding a first-class certificate in the combined gunnery and torpedo courses will receive an allowance of 1s. a day, and those holding second-class certificates 8d. a day.—*Army and Navy Gazette.*

The system of coaling at sea as invented by Engineer-Commander H. W. Metcalfe, the appliances for which are fitted to the sloop Basilisk, will shortly be subjected to further trials. It is expected that one of the battleships of the Home fleet will be detailed to carry out the experiments, and that they will take place in the neighborhood of Spithead. The difficulties which have previously been experienced by the drawing of the splice in the endless whip have now, it is understood, been overcome.

A remarkable coaling feat was accomplished on August 30 by the Grafton, flagship of the Pacific Station, at Esquimalt. Her crew, using shallow baskets only, put on board 600 tons of coal at an average of nearly 195 tons an hour. Two years ago the ship's best performance was 80 tons an hour. She is now believed to have established a world's record for a vessel of her size coaling in similar conditions.—*United Service Gazette.*

M. Pierreval, writing in the *Moniteur de la Flotte* of the recent operations in the Irish Sea, says that the English have this year experienced many accidents amongst their destroyers, and have lost one, the Decoy. Nevertheless, these vessels have, he thinks, given unmistakable proofs of their powers of endurance, and the conditions under which they are manœuvered at night, without navigation lights, render a certain amount of risk unavoidable. With regard to the submarines at Milford, they seem to have attempted an attack on anchored vessels, but did nothing at sea, and their operations are hardly taken seriously. There is, he continues, a certain party both in the fleet and the press which is opposed to these vessels, and he would prefer to wait for more complete information as to their actual performance before venturing to give an opinion upon it.—*United Service Gazette.*

THE TORPEDO MANŒUVERS.—The torpedo manœuvers, which began at 8 a. m. on the 8th ult., concluded on the morning of the 15th ult. There was one serious mishap, viz., the sinking of the destroyer Decoy, belonging to the Blue Flotilla, by the Arun, another vessel of the same flotilla, which was attended, fortunately, by no loss of life, although two of

the Decoy's crew were rather seriously injured. The official object of the operations was thus defined: To ascertain as far as possible the extent of the danger which threatens a fleet compelled by strategic exigencies to move within the radius of action of strong hostile torpedo craft flotillas, but having the advantage of a superiority of force over the enemy in battleships and cruisers, and the support of equally strong torpedo craft flotillas of its own.

The fleet in question (the Blue) was composed of four battleships: the Royal Sovereign, Hannibal, Howe, and Barfleur, with the second-class cruisers Æolus and Melanpus; it was supported by flotillas of destroyers operating from Queenstown, Waterford, and Carrickfergus. Vice-Admiral Sir A. K. Wilson, K. C. B., was in supreme command on the Blue side.

Rear-Admiral C. G. Robinson, with his flag on the second-class cruiser Highflyer, was in command on the Red side, his headquarters being at Milford Haven. The force under his orders was made up of torpedo-gunboats, destroyers, and torpedo-boats, the different flotillas being stationed at Milford Haven, Falmouth, and Loch Ryan, in the north.

On the morning of Monday, the 8th, the Blue fleet was sighted by the Red signal stations in Cornwall at 8 a. m.—the hour when hostilities commenced. At the same time a flotilla of Blue gunboats and destroyers left Queenstown and formed a line across the mouth of the Bristol Channel; the Blue fleet came into touch with them early in the afternoon, and, screened by this protecting flotilla, was off Milford Haven about 4 p. m., when it altered course for Carnsore Point, where it picked up the Blue flotilla of destroyers from Waterford, which convoyed it throught the St. George's Channel, the fleet arriving at Carrickfergus in Belfast Lough on Tuesday at mid-day. On Tuesday afternoon the Blue flotilla from Carrickfergus was sent out to clear the way and mask the Red flotilla at Lock Ryan; this it succeeded in doing, and the fleet, weighing from Carrickfergus late on Tuesday night, passed through the North Channel safely, arriving at its destination (Lough Swilly) on Wednesday morning; the object in view was thus attained, the Blue torpedo craft having successfully defended their fleet in its passage throught the waters threatened by the hostile flotillas. The Blue fleet was equally successful in returning south; but on the last day of the manœuvers, when off Falmouth, one of its cruisers, the Æolus, was torpedoed by the Derwent, one of the Red destroyers, which seems to have been a very creditable achievement, as it was done in a fierce gale, and with a heavy sea running. The net result of the week's exercises, therefore, was that the Blue fleet twice passed in safety, under the protection of its three strong flotillas, through the Irish Sea, the enemy's flotillas of gunboats and torpedo-boats at Milford Haven and Lock Ryan, only losing one cruiser. From the first, the commander of the Blue flotillas boldly took the offensive, blockading and attacking the vessels on the Red side; in this work he apparently lost the greater part of one of his three flotillas and about a third part of another; but he fully succeeded in carrying through the task assigned to him. The losses on the Red side during the various engagements were also considerable, and the report of the umpires on the whole manœuvers will be looked for with much interest.

It is, we believe, admitted that one result of the manœuvers has been to show the capacity of destroyers for protecting a fleet from the attack of torpedo-boats. It is also satisfactory to learn that the new destroyers of the River class, which have met with so much hostile criticism, proved to be excellent sea boats, and came much better through the bad weather experienced than the older vessels.

It seems that on the night of the 13th ult., when the collision occurred between the Arun and Decoy, which proved fatal to the latter, the night was very dark, and it was blowing fairly hard. The Arun, Sturgeon, and Decoy were proceeding in line ahead, without lights, when the Arun, without signal, altered course some 16 points, unperceived by the Decoy,

which vessel was struck amidships. As the Decoy kept afloat for about half an hour, time was thus fortunately given for the rescue of all the crew.—*Résumé from Times.—United Service Institution.*

The changes now going on with ships in commission are of a drastic nature, and they are attributed to Admiral Fisher, who is understood to hold the theory that protected cruisers and such craft are of no use to-day, and that British squadrons should all be armored. It is certainly the common-sense view. We have often pointed out in this column that sloops and such-like craft are perfectly useless, and old cruisers no better. They cannot fight and they cannot run away, and it is a matter of considerable congratulation that the authorities seem at last to have determined to have our fleets war fleets.—*Engineer.*

There is already some indication that the admiralty decision to recall small ships from far distant stations is being carried out. Orders have been given that the third-class cruiser Pearl is to be withdrawn from the Cape of Good Hope without relief. The sloops Vestal, Rinaldo, and Espiegle are also to be withdrawn from the China fleet without relief. The third-class gunboat Tweed is to be paid off in the Reserve at Hong Kong, and her crew sent home on the first opportunity. The orders for commissioning the second-class cruiser Scylla for service on the South Atlantic Station have been cancelled, and the third-class cruiser Tartar is to remain on the station. The paid-off crew of the despatch vessel Alacrity is to be sent home by freight ship.—*United Service Gazette.*

A most interesting and instructive experiment was successfully carried out this week with the new battleship Dominion. She underwent her full speed trials with everything arranged for war conditions. The engine-room was closed down, all bulkhead doors were shut, the staff in charge was limited to the ordinary battleship complement, and everything was as if the ship were actually engaged with an enemy so far as machinery was concerned. The initial difficulties associated with an experiment of this nature can easily be appreciated, and the fact that it has been decided that this condition shall apply to the official trial of all subsequent ships is in itself testimony to the success with which Messrs. Vickers, Sons, and Maxim have overcome those difficulties. Despite the onerous regulations, the Dominion attained a speed of 19½ knots. This speed was attained with the engines making over 125 revolutions and developing 18,438 I. H. P. In other directions rapid progress is being made with the new vessels. The King Edward VII has gone back to Devonport, and will be completed there as rapidly as possible, and the Commonwealth is in a very forward state at Fairfield. The New Zealand has only been ten months off the stocks, and work in other directions has somewhat delayed her; but the Britannia, which is also building at Portsmouth, is to be launched by Lady Londonderry on December 10.—*Army and Navy Gazette.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Roma	12,625	Gov't Yard, Spezia.	Building.
Napoli	12,625	Gov't Yard, Naples.	"
X	12,625	Gov't Yard, Castellamare.	Projected.
Vittorio Emanuele	12,625	Gov't Yard, Castellamare.	Launched Oct. 12, 1904.
Regina Elena	12,625	Gov't Yard, Spezia.	Launched June 19, 1904.
Armored Cruiser.			
Francesco Ferruccio.	7,400	Gov't Yard, Venice.	Under trial.

THE NAVAL ESTIMATES FOR 1904-05.—The estimates, ordinary and extraordinary, for 1904-05 amount to 127,191,083.16 lire (£5,087,643 6s.) as compared to 127,181,734 lire (£5,087,269 6s.) voted for last year, showing a

decrease of 9,348.94 lire (£374). The principal differences between the two budgets lies in that whereas in the ordinary budget for this year there is an increase of 67,010 lire (£2,680 8s.) in the general expenses, and of 339,833.90 lire (£13,593 7s) in the expenses for the fleet, there is, on the other hand, in the extraordinary estimates a decrease of 30,210 lire (£1,208 15s.) and 376,633.9 lire (£15,065 7s.) respectively, which sums balance each other.

The following are the principal items:

ORDINARY ESTIMATES—GENERAL EXPENSES.

	Proposed, 1904-5. Lire.	£	s.	Voted, 1904 £	s.
Ministry of Marine	1,534,512.50 =	(61,380	10)	58,700	2
Pensions, etc.	5,830,000.00	(233,200	0)	233,200	0
Expenditure for the Mercantile Marine	9,580,322.00	(383,212	18)	383,212	18
Total	16,944,834.50	(677,793	8)	675,113	0

EXPENDITURE FOR NAVAL SERVICES.

Ships fitting-out, in reserve, etc.	6,070,000 =	(242,800	0)	242,800	0
Officers' corps in the navy	3,660,000	(146,400	0)	146,400	0
Naval engineers, etc.	1,351,000	(54,040	0)	54,040	0
Paymasters and victualling department	829,000	(33,160	0)	32,760	0
Medical staff	690,000	(27,600	0)	27,600	0
Men's pay	12,900,000	(516,000	0)	504,000	0
Gratuities, etc.	2,394,000	(95,760	0)	84,240	0
Assistant officials	120,000	(4,800	0)	4,800	0
Technical civil personnel	1,415,920	(56,636	12)	55,961	19
Minor dockyard officials and staff	1,489,310	(59,572	8)	59,280	0
Police	282,000	(11,280	0)	11,320	0
Semaphore and carrier pigeon service	543,000	(21,720	0)	214,000	0
Personnel of coast local defence	360,000	(14,400	0)	14,000	0
Victualling	8,600,000	(344,000	0)	336,000	0
Barracks, lighting, etc.	207,000	(8,280	0)	8,280	0
Hospital services	548,000	(21,520	0)	21,520	0
Honorary distinctions	15,000	(600	0)	600	0
Coal and other heating material	6,000,000	(240,000	0)	240,000	0
Ship's commodities	1,700,000	(68,000	0)	68,000	0
Personnel for building and fortification works	110,500	(4,420	0)	4,299	4
Naval Institute	322,100	(12,884	0)	13,296	0
Recreation squares for Naval Academy and Engineering School	54,016	(2,160	13)	2,717	6
Hydrographical service	296,662	(11,866	10)	11,698	10
Law charges	32,000	(1,280	0)	1,280	0
Travelling expenses, etc.	600,000	(24,000	0)	24,000	0
Transport of material	125,000	(5,000	0)	5,000	0
Material for maintenance of fleet	5,538.000	(221.520	0)	223,200	0
Labor for maintenance of fleet	4,800,000	(152,000	0)	208,640	0
Material for maintenance of guns and armament	3,826,000	(153,040	0)	154,000	0
Guns and armament	2,200,000	(88,000	0)	88,000	0
Labor for maintenance of guns, etc.	3,023,025	(120,921	0)	120,921	0
Material and labor for buildings	2,500,000	(100,000	0)	100,000	0
New construction	21,200,000	(848,000	0)	896,000	0
Fuel, stores, dockyard plant, etc.	5,200,000	(208,000	0)	200,000	0
Total	99,001,533	(3,960,061	3)	3,946,467	19

EXTRAORDINARY ESTIMATES—GENERAL EXPENSES.

	Proposed, 1904-5. Lire.	£ s.	Voted, 1903-4. £ s.
Half-pay, etc.	26,000 =	(1,040 0)	1,040 0
Pay for officers and officials for special Duties	20,830	(833 4)	2,041 12
Total	46,830	(1,873 4)	3,081 12

EXPENDITURE FOR NAVAL SERVICES.

New construction	4,606,802 =	(184,272 2)	199,337 8
Coast defence	200,000	(8,000 0)	8,000 0
Torpedo equipment	200,000	(8,000 0)	8,000 0
Total	5,006,802	(200,272 2)	215,337 8

SUMMARY.

Ordinary Expenditure.

General expenses, etc.	16,944,834 =	(677,793 8)	675,113 0
Expenditure for naval services	99,001,533	(3,960,061 3)	3,946,467 19

Extraordinary Expenditure.

General expenses, etc.	46,830	(1,873 4)	3,081 12
Expenditure for naval services	5,006,802	(200,272 2)	215,337 8
Depreciation of ships in commission	3,500,000	(140,000 0)	140,000 0
Rent of Crown lands, used for naval purposes	2,691,084	(107,643 9)	107,269 7
Grand total	127,191,083	(5,087,643 6)	5,087,269 6

NEW CONSTRUCTION.

A sum of 25,806,802.05 lire (£1,032,272 2s.) is demanded for new construction, as compared with £896,000 voted for last year, being a decrease of 1,200,000 lire (£48,000). The sum is apportioned as follows:

	Lire.	£ s.
A first-class battleship of the Vittorio Emanuele type to be laid down at Castellamare	500,000 =	(20,000 0)
For the construction and completion of the following first-class battleships—		
Vittorio Emanuele at Castellamare and Naples	6,000,000	(240,000 0)
Regina Elena at Spezia	6,000,000	(240,000 0)
Roma at Spezia	3,500,000	(140,000 0)
Napoli at Castellamare and Naples	3,500,000	(140,000 0)
The first-class armored cruiser Francesco Ferruccio at Venice	500,000	(20,000 0)
The torpedo-boat destroyers Zeffiro and Espero at Naples	400,000	(16,000 0)
Two lagoon gunboats at private yards	20,000	(800 0)
The submarines, Glauco at Venice and A, B....	600,000	(24,000 0)
C and D	800,000	(32,000 0)
The transport-avisos Bronte and Sterope at Leghorn	1,000,000	(40,000 0)
Fourteen first-class torpedo-boats	2,400,000	(96,000 0)
Two cistern vessels at Venice	50,000	(2,000 0)
Some harbor service vessels	336,802	(13,472 2)

For reconstruction of first-class battleship Italia, a vote of 700,000 lire (£28,000), out of a total vote of 3,000,000 lire (£120,000). For repair of

repair depot-ship Volcano, a vote of 280,000 lire (£11,200), out of a total vote of 680,000 lire (£27,200).—*United Service Institution.*

The King of Italy launched at Castellamare, near Naples, the new battleship Vittorio Emanuele III, sister vessel of the Regina Elena, recently set afloat at Livorno. She has twenty-eight Belleville boilers, her length is 132.6 meters and her breadth 22.4 meters; she carries fourteen large and twenty-eight smaller guns; her engines are of nineteen thousand horsepower. Two other vessels of the same type, to be christened Roma and Napoli respectively, are now under construction.—*United Service Gazette.*

RELATIVE RANK OF NAVAL AND MILITARY OFFICERS.—A Royal Decree has recently been issued regulating the relative ranks of officers of the navy and army. For the future, admirals, vice-admirals, and rear-admirals are to rank with generals, lieut.-generals, and major-generals respectively; captains with colonels; frigate-captains with lieut.-colonels; corvette-captains with majors; lieutenants with captains; sub-lieutenants with lieutenants; midshipmen with sub-lieutenants. The heads of the other branches of the navy rank with major-generals, and the other ranks with the corresponding ranks in the army.

THE NEW ORGANIZATION OF THE TORPEDO FLOTILLAS.—By a Royal Decree, a "Superior Command of Torpedo-boats" has been substituted for the old "Inspection." All the first and second-class torpedo-boats will come under the new "Command," with the exception of those stationed in the naval ports, which are under the orders of the departmental chiefs, the district commanders, and the commandant of the maritime defence. The boats will be stationed as follows:

At Civita-Vecchia, under the "Superior Command," will be the seven sea-going torpedo-boats Aquilla, Avvoltoio, Condore, Nibbio, Falco, Pellicano, and Sparviero, with twenty-four second-class boats, of which two will be stationed at Elba, three at Gaëta, and two at Leghorn for the instruction of boys at the Naval School during the time of the normal course.

At Genoa, under the command of the naval department, will be seven first-class boats, of which four will be detached to Santa Margherita and Portosino.

At Messina, under the orders of the local maritime defence, eighteen first-class boats.

At Tarento, under the orders of the reserve division of the fleet, twelve.

At Ancona, under the orders of the reserve division of the fleet, four.

At Maddalena, under the district commander, eighteen.

At Venice, under the orders of the commandant of the 3rd marine department, eight.

All other boats, stationed elsewhere than as above, are to be transferred henceforth to the headquarters of the new command.

STEAM TRIAL.—The new first-class battleship Regina Margherita has completed her trials successfully. Under natural draft, with the engines developing something over 14,000 I. H. P., the ship maintained a speed of 19.3 knots, or more than a knot over the contract, for six hours; under forced draft, with the engines developing 20,600 I. H. P., the speed was 20.2 knots during a run of an hour and a half. The ship was laid down in November, 1898, and launched in May, 1901, having been built in the Royal Dockyard at Spezia, while the engines and boilers were constructed by the firm of Ansaldo, at Genoa. The delay in her completion has been due to the small amounts voted for new construction during recent years, other ships being delayed from a similar cause. She is a sister ship to the Benedetto Brin, which is completing at Naples, after having been built at Castellamare.

Her dimensions are as follows: Length, 413 feet between perpendiculars, 433 feet over all; beam, 78 feet; displacement, 13,426 tons, with a draft

of 27 feet. Protection is afforded by a water-line belt of 6-inch Terni steel, between the barbettes, tapering to 2 inches at the extremities; from this belt rises a citadel extending between the barbettes to the upper deck, also of 6-inch steel, while there is in addition a 3-inch armored deck, with a 1.2-inch splinter deck above. The barbettes for the heavy guns are of 8-inch steel, with 8-inch hoods; the turrets for the secondary armament are of 6-inch steel. The transverse bulkheads are 10-inch and 8-inch steel.

The armament consists of four 12-inch guns in pairs in barbettes, one forward and one aft; four 8-inch Q. F. guns singly in turrets, sponsoned out two on each beam at corners of casemate; twelve 6-inch Q. F. guns in central casemate, with ten 12-pounders, eight 3-pounders, and four machine guns; there are also four submerged torpedo-tubes. It was originally intended that the armament should consist of two 12-inch guns in a barbette aft, and ten 8-inch guns in pairs in turrets, forward and on the beam.

Steam is supplied by 28 Niclausse water-tube boilers, working at a pressure of 300 lbs.; they are arranged in six compartments, three on each side of the ship, divided by a longitudinal water-tight bulkhead. Her nominal coal capacity is 1000 tons, but she can carry 2000 when required, her radius of action being 5000 to 10,000 miles at 10 knots nominal speed. She has three funnels and two military masts, without the heavy lower fighting tops.

REPORT ON THE EXPLOSION ON BOARD THE MARCO POLO.—The Ministry of Marine has issued the following account of an explosion which occurred on board the Italian cruiser Marco Polo at Chemulpo: "On the 9th ult., in Chemulpo waters, a 152-mm. (5.98-inch) shell exploded by accident in the magazine of the first-class armored cruiser Marco Polo. The magazine was at once flooded in order to avoid certain disaster. A seaman and two firemen who were among the men who hurried into the magazine were asphyxiated by the fumes. Seventeen others, including Lieutenant Riccardi and Engineer-Lieutenant Russo, were less seriously affected, and are on the way to recovery. The cause of the explosion has not yet been ascertained, but the result of the inquiry which is being held is expected shortly. Admiral Grenet, commanding the naval division of which the Marco Polo is the flagship, reports that in this dangerous accident the officers and crew of the cruiser behaved admirably."

A NEW SUBMARINE.—The submarine Delfino, having completed her trials at Spezia on 30th August, left for Naples escorted by the torpedo-boat destroyer Ciclope. She was to go to Naples in short stages, and when there to take part in the combined naval and military manœuvers. The hull of the Delfino is constructed of steel plates 30-mm. (1.18 inches) in thickness, and her form is that of a cigar, her length being 78.74 feet, and her beam 9.5 feet. Her displacement varies, according to the extent of her submersion, from 95 to 107 tons. Her engines are worked solely by electricity furnished by 300 accumulators. She has three propellers; one aft for movement ahead or astern, and the other two above for the work of submersion and bringing her to the surface again. The little turret is glazed so that a look-out may be maintained when the boat is submerged. Her sole armament consists of two torpedo-tubes. Her oxygen supply is sufficient for a crew of twelve persons.—*United Service Institution.*

The *Moniteur de la Flotte* states that the Italian Government has given the Schichau Works at Elbing an order for sixteen destroyers of 26 knots speed.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Kashima.....	16,500	Vickers.	Building.
Katori	16,500	Armstrong.	"

VESSELS BUILDING.—*Continued.*

Name.	Displacement.	Where Building.	Remarks.
Armored Cruisers.			
1, 2, 3,	9,900		Projected.
Protected Cruisers.			
3, 4	5,000		Projected.
Niitaka	3,470	Yokosuka.	Launched.
Tsuchima	3,470	Kure.	"
Otawa	3,000	Yokosuka.	"

With the object of expediting the building of battleships in Japan, the agents of the Mikado's Government have now closed a contract with the Carnegie Steel Company at Pittsburg for 7500 tons of the finest grade nickel-steel plates.—*United Service Gazette.*

The *Yacht* states that the Holland Torpedo-boat Company is building for Japan, under a contract entered into last June, five submarines of 36 meters length. They are to be delivered before the end of this year and are to cost 875,000 francs each.

The Japanese battleship Yoshima, whose loss by mines last June is now officially admitted by the Japanese, was an Elswick-built ship of the Royal Sovereign type, with hoods to the big guns. Her loss keeps up the curious record of the war, that the Russians, though beaten, have destroyed more than they have lost. Japan has lost two first-class ships, Hatsuse and Yoshima; Russia but one battleship. On the other hand, while Japan has lost but one cruiser—by collision—Russia has by neutral ports lost one battleship and two cruisers. She has had also two cruisers of small fighting value sunk. We do not know the condition of the ships at Port Arthur. It is probably bad; but if otherwise, then things are by no means settled in the matter of naval superiority.

The latest story of the loss of the Yoshima is that she was sunk by one of the two small submarines which Russia has or had—despite denials—at Port Arthur. For ourselves, we do not credit the tale; had a submarine done it Russia would have let the world know the fact.—*Engineer.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Emperor Paul I	16,000	St. Petersburg (Baltic Yard).	Building.
Andrei Pervosvannui	16,000	St. Petersburg (Galerney Island).	"
Slava	13,516	St. Petersburg.	Launched Aug. 29, 1903.
Evstafi	12,500	Nicolaiev.	Building.
Ivan Zlatoust	12,500	Sevastopol.	"
Coast Defence Iron Clad.			
Admiral Boutakof	6,000	St. Petersburg.	Building.
Protected Cruisers.			
Kagul	6,750	Nicolaiev.	Under trial.
X	6,700	"	Building.
Otchakof	6,750	Sevastopol.	Under trial.
X	6,750	"	Building.
Vitiaz	6,750	St. Petersburg.	"
X	6,750	"	"
Kalgoula	3,200	Nicolaiev.	Building.
7	3,200	Dantzic (Schichau).	Building.
8	3,200	St. Petersburg.	Projected.

The battleship Imperator Alexander II is being subjected to a thorough overhauling and refitting. Teak is being substituted for pine in the upper deck as being stronger and less liable to deterioration. The wooden sheathing of the bridge is to be replaced by steel. As in the case of the Boyarin, which was built in Denmark, this steel is of the slightly magnetic kind, supplied by Krupp, from Essen, at a cost of 2000 marks a ton, as against the ordinary steel costing only 216 marks. On the gun-deck also the wood-work will be replaced by lapidite "No. 1," and that of the boiler and engine hatches and the like by steel. The questions of re-armament, electric ventilation, new dynamos, etc., are left for consideration by the Constructional Committee. Certain changes in the position of magazines will be made in accordance with the lessons of the war. The whole is estimated to cost some 1,200,000 roubles (£125,000). The armor is good, and new boilers have already been fitted.

The coast defence battleship Admiral Grieg has been subjected to a thorough overhaul, a great part of the side armor having been removed to allow of fresh backing being fitted and strained bolts being replaced. A new upper deck has been fitted, and new backing put under the turrets, while superfluous wood-work has been removed from the ward-room and elsewhere.

In spite of careful working out of details and its skilful construction, the mounting for 75-mm. guns, devised by Colonel Müller, has not proved satisfactory, and recourse has been necessary to the Canet system. It was too complex and difficult to handle, and so not favorably regarded on board ship. Accordingly, ships now projected will not be supplied with this mounting. The inventor is now at Port Arthur. It is possible that improvements in the future may lead to its re-adoption.

Ten torpedo-boats under construction at the Baltic Works and as many at the Neva Building Yard have been taken over by the navy and christened, respectively, Kasatka, Skat, Makrel, Sterliad, Forel, Osetr, Losos, Bieluga, Som, and Shchuka, while torpedo-boat No. 150, completed at the first-named, last year, is now known as the Delphin.

The eight destroyers of the Buïny type are being subjected to considerable alterations and improvements as regards armament and torpedo equipment, the result of experience in the fighting against the Japanese, which will also be adhered to in future construction.

The destroyer Grozny, under construction at the Neva Yard, with a displacement of 350 tons, differs somewhat also from the Buïny type, both as to hull and engines, the outcome of experiments made two years ago with four of the Vnimatelny type.

Two more torpedo-boats from the Baltic Yard and one under construction at the Neva Yard were also taken over some time back, to be known as the Nalim, Okun, and Peskar.

All large ships now under construction are to be fitted with the Spencer-Miller (American) apparatus for coaling as improved on by Engineer-Lieutenant Metcalfe (of our navy). It is proposed to offer prizes for rapid coaling and rapidly getting up steam; and also to supply stokers with the "Clément" goggles, as adopted in the French service.

It has been decided by the council to form an Odessa battalion of sailors especially for transport purposes in time of war, and the training of personnel in such duties in peace. Officers will be selected for it from all branches by the commandant of the Odessa Military District. Recruits will be chosen from the maritime or lacustrine districts, also from skilled mechanics and those trained in technical schools.

Among the work of the hydrographic department for the past year may be mentioned the carrying on of the survey of the Gulf of Onega, which was begun as long ago as 1887. As regards the Frozen Ocean, the sea route to Siberia through the Kara Gates was further explored. The passage of them is possible only when the Yugor Shar, already explored, is closed by ice. There was also carried out a survey, very important commercially, of the embouchure of the river Pechora, opening out a short

and safe route to the ocean, and greatly facilitating the export of timber from the basin of that river, which already amounts to some millions of roubles. The Murman Coast, in the same sea, has been further surveyed, and various inaccuracies in the existing maps rectified, and the necessity for further efforts made clear.

A work is announced from the pen of the late Vice-Admiral Makarov entitled, "Problems of Naval Tactics," and is a continuation of "An Analysis of the Elements Constituting the Fighting Strength of a Ship," by the same author. Three lectures on Tactics, delivered in 1896 at the Kronstadt Naval Institute, have been amplified into this work. The gist of it seems to be that so much time and effort are taken up in the routine of keeping the ship in good order merely as a ship, that its *raison d'être* as a fighting unit is apt to be neglected. He quotes General Dragomirov, to the effect that the same is very apt to occur among troops. His motto is: "Be mindful of War!" It is curious that he reflects that a state of war is now so rare that few opportunities are afforded for putting the theories of tacticians in practice!

TRAINING OF CADETS.—In order to enable naval cadets during their sea training to become familiar with guns of the latest pattern, the second-class cruiser Rynda has had her 6-inch guns of the 1877 model, on General Pestich's mountings, replaced by four quite modern 75-mm. guns, on Colonel Müller's carriages, while her 4-pounders have given place to two 47-mm. single-barrelled ones with quicksilver compressors. The former are from the Perm and the latter from the Obuchoff factories. Hitherto the instruction in the training squadron has been carried out with obsolete guns or the handling of 5-barrelled Hotchkiss guns. The first-class cruiser Admiral Kornilov, which had a more modern armament, was this year removed from the squadron, thus leaving the Rynda and the torpedo-boat Pylki the only approximately modern vessels available.

It is proposed in official circles to establish in one of the Black Sea ports a second Cadet College for the navy. The sole one now existing at St. Petersburg has shown itself insufficient to turn out a sufficient supply of officers for the Home and Pacific squadrons, let alone the Mediterranean. Sevastopol or Nicolaieff are spoken of as the places likely to be decided on for the purpose, though at Odessa hopes are entertained that it might be located there. At the first-named, even in winter, lie ships of all types almost fully equipped for the instruction of the cadets by actual practice. The second has, on the other hand, the recommendation of affording an excellent roadstead for the reception of a training squadron, while the conditions of life there are more suitable for cadets. Moreover, when the 30-foot canal is complete, Nicolaieff will be in no respect inferior to Sevastopol as a naval center, visited by even the largest ships, or in importance generally as a naval station, even if it does not outdistance it.—*Kronstädtski Viéstnik.* (From the *United Service Institution.*)

The *Russkoe Slovo* publishes particulars of the blowing up of the Russian gunboat Sivutch at Newchwang. On the withdrawal of the Russians it was felt that the boat was useless to them, and in a dangerous position for her crew. In harbor she would not be able to withstand an attack from the Japanese torpedo-boat destroyers, and it was hardly likely she would succeed in escaping if she put to sea, for her utmost speed was not more than 10 knots. Her displacement was 940 tons. She carried a 9-inch Krupp gun aft and a 6-inch gun in her bows, and some smaller guns. On August 1 Captain Stratanovitch, her commander, received orders to blow her up. Before doing so he removed the Hotchkiss guns and the Baranovski landing gun, and the breech blocks from the big guns. The crew left in the launches, the majority to join the army with the guns and the others remaining on the launches to navigate them up the river. On August 2, pyroxiline cartridges were placed in the ship fore, aft, and

amidships, and only two minutes elapsed between the explosion of the first and last cartridge, after which some of her remains were still visible, though soon to disappear in the river mud. The crew watched the explosions from the banks, and many of them reverently crossed themselves.

The *Petit Var* states that while some of her sister ships of the Russian Volunteer Fleet have been ploughing the seas and exercising with a "rare vigilance" the right of search, the Orel has been undergoing at Toulon transformation into a floating hospital. She is to be furnished with 450 beds for wounded men and 50 for wounded officers. On the main deck will be the sleeping accommodation for her officers and crew; the cabin of the chief medical officer, who ranks as rear-admiral; the bandaging or dressing room, with its tables, its taps of hot and cold water, and its lift to convey patients to and from the operating room, which is situated on the bridge above it; the galley, the laundry, the dispensary, the laboratory, the dissecting room, and the isolating wards. Between decks will be the officers' living rooms, the hospital wards for officers and men, the doctors' and nurses' cabins, and the baths and lavatories. Below will be stores of all sorts. Four cows will be carried to supply milk.

The *Moniteur de la Flotte* devotes a leader to the prospects of the Russian Baltic Fleet, always apparently on the eve of starting for the Far East, but a long time nevertheless in taking its actual departure. The strength of the fleet is estimated at seven battleships, of from 9500 to 13,000 tons, two armored cruisers, of 8500 and 6000 tons, respectively, with six protected cruisers, and seven destroyers. Quite a formidable force considering that Togo's whole fleet has only five battleships, though these are supplemented by eight armored cruisers. It is expected that the ships will proceed at 12 knots, as the most economical speed, at which rate eight or nine weeks would be spent on the voyage. At the end of that period it may be expected that Port Arthur will have fallen, leaving Vladivostock as the only harbor available. By that date Vladivostock will be frozen up, but the Russians are confident that their ice-breaking vessels will prove equal to the task of keeping a passage open. The writer concludes with the observation, that so bold an undertaking deserves success, if success is possible!—*United Service Gazette.*

Of the 37 ships in the Baltic fleet now bound to the Far East, more than half are entirely new. They have been constructed and fitted out in great haste, and many defects are to be expected. Furthermore, the crews are green and inexperienced. Most of the engineers and machinists are untried, and few, if any, of the men on board have ever participated in a battle. The material of which Russian armies and navies are made is not so good as that of other European nations or the United States, although, as has been demonstrated in every emergency, the sailors and soldiers are great fighters.

The Baltic fleet is composed of the following vessels:

	Tonnage.	Launched.
BATTLESHIPS.		
Imperator Alexander III	13,516	1901
Oslyabya	12,674	1898
Sissoi Veliky	10,400	1894
Navarin	10,206	1891
Borodino	13,516	1901
Orel	13,516	1902
Kniaz Suvaroff	13,516	1902
ARMORED CRUISERS.		
Dmitri Donskoi	6,200	1883
Admiral Nakhimoff	8,524	1885

PROTECTED CRUISERS, FIRST CLASS.

Aurora	6,731	1900
Oleg	6,675	1903

PROTECTED CRUISER, SECOND-CASS.

Svyetlana	3,862	1896

PROTECTED CRUISERS, SECOND CLASS.

Almaz	3,825	1903
Zemtchug	3,106	1903
Izumrud	2,106	1903

DESTROYERS.

	Tons.	Speed.
Buini	350	27
Bravi	350	26½
Blestyashtchi	350	26½
Buistri	350	26½
Bodri	350	26½
Byedovi	350	26½
Bezuputchiu	350	26½
Prouzitelni	350	26½
Gromki	350	26½
Grozni	350	26½
Podoijeny	350	26½
Rezoy	350	26½

AUXILIARY CRUISERS AND TRANSPORTS.

Don, Ural, Terek, Kuban, Irtish, Anadye, Argun, Smolensk and Petersburg, scout cruisers, armed. (Converted merchant ships of high speed.)

Hospital ship Orel.

REPAIR SHIPS.

Kamchatka, Ocean.

COLLIERS.

Korea, Kitai, Kniaz, Gorcha, Kov.—*Nautical Gazette.*

THE START OF THE BALTIC FLEET.—The long-heralded setting out of the Russian Armada for the Far East has been signalized, at the very outset, by a fleet engagement, which is destined to rank as unique in naval history. We cannot recall another instance in which an admiral starting to the relief of a beleaguered and far-distant fortress, was so fortunate as to strike the first telling blow in home waters, and sweep through the enemy's lines, delivering his broadsides without the loss of a single man, or so much as the scratching of the war paint on his own battleships and cruisers.

The collision occurred at night and in thick weather. Warned by the fate of the Port Arthur fleet, Admiral Rojestvensky and his staff were keeping a strict lookout for torpedo attack, when suddenly they were confronted by a numerous fleet of suspicious-looking craft, filled with uncouth men, some of whom were wielding sharp knives, while others were seen in the very act of hauling and pulling on objects that were floating in the sea. Here, then, was the enemy, caught in the very act of sowing mines in the path of his Majesty's battleships. Despite the sudden peril that thus confronted it, the traditions of the Russian navy were nobly maintained. There was no panic—merely a sharp word of command—and the united broadsides of four of the very latest and most powerful battleships of the day opened with telling effect. After twenty minutes of spirited and accurate firing, in which the greatest self-possession was shown by all ranks, the admiral, seeing that the enemy made no reply, steamed to

the southward, leaving behind him two fishermen killed, several wounded, and one fishing boat sent to the bottom. It is generally agreed that naval history, ancient or modern, fails to furnish a parallel, either in brevity or effectiveness, to this Battle of the North Sea.

Its effect upon the spirits of the beleaguered garrison at Port Arthur must prove to be highly stimulating; and there can be little doubt that such an astute admiral as Togo will make a mental note of the keen-eyed vigilance, dashing courage, and deadly efficiency shown thus early in its career by the Baltic fleet.

As regards the material of which the fleet is composed, although it includes four battleships which we consider to be, in some respects, the best in the world, the fleet as a whole is composed of so many different types, that it is totally lacking in that homogeneity which tacticians of the modern school consider to be of prime importance to the effectiveness of a fleet. The most important element is, of course, the four recently-completed battleships of the Borodino class, ships that are very similar to the Czarevitch, now sheltering, badly crippled, under the protecting wing of a neutral port. They embody, however, certain improvements over that ship. The vessels are the Borodino, Orel, Imperator Alexander III, and Suvaroff. They carry four 12-inch and twelve 6-inch guns, besides a numerous battery of smaller rapid-fire pieces. The belt of Krupp steel varies from 9 inches amidships to 4½ inches at the ends. The heavy guns are protected by 11 and 10 inches of armor, and the six turrets that contain the twelve 6-inch guns in pairs, carry six inches of armor. Theoretically, these ships are unsinkable by gun fire at ordinary battle ranges. In addition to the protective deck at the waterline, which is 4 inches thick, they have an upper protective deck, 2 inches in thickness, and the space between them is entirely filled with coal. Moreover, two vertical bulkheads of 4-inch armor extend throughout the ship at about 8 or 10 feet from the side. Compared with the latest battleship designs of other navies, the secondary battery of 6-inch guns is too light for its purpose. Our own Connecticut carries secondary batteries of 7 and 8-inch guns, the Lord Nelson of the British navy carries ten 9.2-inch guns in its secondary battery, while the latest Japanese carry four 10-inch guns.

The battleship Osliabia is practically a sister ship to the Peresviet and Pobieda, now imprisoned at Port Arthur. She was half way on her voyage to the Far East at the outbreak of the war, and was recalled because of the early naval ascendency gained by Japan. She is distinguished by an abnormally high freeboard of about 30 feet, and she would, of course, present a lofty target to the enemy. She is armed with four 45-caliber 10-inch guns and eleven 45-caliber 6-inch guns, besides forty-six smaller pieces. Her belt, which extends almost to the ends, is of 9-inch Harvey nickel-steel, with a shorter 5-inch belt above it, extending for a third of the length amidships. The 6-inch guns are carried in casemates protected by 5 inches of armor. The 10-inch gun is a powerful piece, but not by any means a match for the 12-inch wire-wound guns of the Japanese. The Osliabia carries two submerged and four above-water torpedo tubes. On trial she made a speed of 18.3 knots. The other two battleships are comparatively obsolete vessels, that could only find a place in a "scratch" squadron, such as this; the Sissoi Veliky, built in 1894, is a ship of 9000 tons and 16 knots speed. She carries four 35-caliber 12-inch guns of low velocity and six 45-caliber 6-inch rapid-fire guns. Her half-dozen torpedo tubes are carried above water. She has a partial belt of 16-inch Creusot armor, a deck 3 inches thick on the slopes, and 5 inches of protection to her 6-inch guns. The Navarin, built in 1891, is a vessel of 10,000 tons and 16 knots. She carries four 12-inch guns of the same pattern as those on the Sissoi Veliky, and eight 45-caliber 6-inch pieces. Her 16-inch waterline belt and her 12-inch turrets are protected by the old compound iron and steel armor, whose resisting power is very small against modern artillery. Moreover, she is a ship of low freeboard and limited coal supply.

It is quite a question whether the crack battleships of the Baltic squadron would not be better off without these two old and inefficient "armorclads."

Of the cruisers, two, the Admiral Nakhimoff, of 8000 tons and 18½ knots, and the Dmitri Donskoi, of 5880 tons and 15.5 knots, are old armored cruisers. The former was launched in 1885, and the latter in 1883. The Admiral Nakhimoff was reconstructed in 1899, but she still carries the soft compound armor, as does the Donskoi also. The Nakhimoff is armed with eight 6-inch and ten 4.7-inch, and the Donskoi with six 6-inch and ten 4.7-inch guns, of modern type. These two obsolete craft can never hope to stand up against the modern powerful armored cruisers of Japan, like the Asama.

The fleet also includes six protected cruisers, whose presence in the Far East can have only an indirect effect in raising the siege at Port Arthur. Their province will be to act the part played by the Vladivostock cruisers before they were put out of commission by Admiral Kamimura's squadron, namely, that of raiding the Japanese transports and merchant vessels. In this, because of their high speed, they can, undoubtedly, prove very troublesome to the Japanese by distracting the attention of the blockading fleets at Port Arthur and Vladivostock, and by constituting a menace to the Japanese communications by sea. The fleet consists of the Aurora, of 6630 tons and 20 knots, carrying eight 6-inch guns, sister to the Pallada and Diana, now confined in Port Arthur; the Oleg, of 6250 tons and 23 knots, carrying twelve 6-inch guns, a new vessel of the Bogatyr type (the Bogatyr went on the rocks at Vladivostock, was floated, and is now repairing at that port); the Jemtchug and Izumrud, of 3200 tons and 22½ knots speed, carrying six 4.7-inch guns, sisters to the Boyarin, sunk by a mine at Port Arthur or Dalny; the Svietlana, of 3900 tons and 21½ knots speed, carrying six 6-inch 45-caliber guns, besides the Almaz, of 3000 tons and 25 knots speed, carrying six 4.7-inch guns, a sister vessel to the Novik, of which we heard so much during the earlier Port Arthur operations.

The fleet is proceeding to the Far East in two divisions, the smaller vessels, including the torpedo-boats, going by the Suez Canal and Indian Ocean, and the larger vessels going by way of the Cape of Good Hope. What will be the fate of the squadron? We must confess that, in view of its auspicious start, it is impossible to predict with any semblance of certainty just what it may do. But one thing is certain—if it should succeed in navigating the 17,000 miles that separate it from the Far East, and should then meet and demolish the well-seasoned ships and crews of Togo and Kamimura, raise the siege of Port Arthur, and transfer the command of the sea from the flag of Japan to that of Russia, it will have accomplished a feat that seems, even with the Battle of the North Sea fresh in our minds, altogether beyond human possibility.—*Scientific American.*

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Protected Cruisers.			
Reina Regente.....	8,372	Ferrol.	Building.
Isabel la Catolica	8,500	Canaca.	"

SWEDEN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Coast Defence Battleships.			
Oscar II.....	4,200	Stockholm.	Building.
Manligheten.....	3,650	Malmö.	Launched.
Tapperheten	3,650	Stockholm.	"
Armored Cruiser.			
Fylgia.....	4,000	Stockholm.	Building.

The *Moniteur de la Flotte* says that the new Sweedish naval budget will total 18,125,000 francs, an increase of 500,000 francs over the preceding one. A new battleship and several torpedo-boats are to be laid down.

At the present time there are three armored gunboats, one torpedo-boat destroyer, and one submarine building for the Swedish navy, the torpedo-boat destroyer in England and the other vessels in Sweden. The submarine will have 80 tons displacement; length, 65.6 feet; and beam, 16.4 feet. Her speed will be 9.5 knots when at the surface and 7 knots when submerged. The five new vessels are expected to be ready for their trials before the winter. The *France Militaire* says that, including them, the Swedish navy will then consist of the following vessels: Twelve armored coast defence ships, of from 3100 to 4270 tons; four monitors, of 1500 tons; seven armored gunboats, of 460 (?) tons; five torpedo gunboats, of 800 tons; nine gunboats, of from 500 to 600 tons; one gunboat of 280 tons, two torpedo-boat destroyers, thirty-one torpedo-boats, eighteen of the first-class, and various out-of-date vessels, in use as training ships or other auxiliaries.—*Engineer.*

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	Degree of Completion Nov. 1, 1904. per cent.	Dec. 1, 1904. per cent.
	Battleships.				
12	Ohio	18	Union Iron Works.	100	....
13	Virginia	19	Newport News.	71.2	73.4
14	Nebraska	19	Moran Bros. Co.	61.4	63.6
15	Georgia	19	Bath Iron Works.	67.5	69.7
16	New Jersey	19	Fore River Shipbl'g. Co.	70.7	72.3
17	Rhode Island	19	Fore River Shipbl'g. Co.	73.5	75.1
18	Connecticut	18	Navy Yard, New York.	56.0	58.7
19	Louisiana	18	Newport News.	61.5	64.7
20	Vermont	18	Fore River Shipbl'g. Co.	25.8	29.5
21	Kansas	18	New York S. B. Co.	31.2	35.6
22	Minnesota	18	Newport News.	46.6	50.2
23	Mississippi	17	Wm. Cramp & Sons.	11.9	15.3
24	Idaho	17	Wm. Cramp & Sons.	10.6	13.4
	Armored Cruisers.				
4	Pennsylvania	22	Wm. Cramp & Sons.	94.8	97.
5	West Virginia	22	Newport News.	95.5	97.
6	California	22	Union Iron Works.	65.	66.7
7	Colorado	22	Wm. Cramp & Sons.	97.1	98.4
8	Maryland	22	Newport News.	92.2	93.4
9	South Dakota	22	Union Iron Works.	63.	64.1
10	Tennessee	22	Wm. Cramp & Sons.	54.6	58.7
11	Washington	22	New York Shipbl'g. Co.	50.2	55.3
	Protected Cruisers.				
16	Chattanooga	16½	Lewis Nixon.	97.	99.1
17	Galveston	16½	Wm. R. Trigg Co.	94.	95.
20	St. Louis	22	Neafie & Levy Co.	54.	56.6
21	Milwaukee	22	Union Iron Works.	60.	63.2
22	Charleston	22	Newport News.	84.3	86.1
	Gunboats.				
17	Dubuque	12	Gas Engine & Power Co.	68.2	72.8
18	Paducah	12	Gas Engine & Power Co.	64.9	68.1

The secretary of the navy has approved the proposals for the new battleship New Hampshire and the new armored cruisers Montana and North Carolina. They have been sent to the public printer and will be issued in a short time. The chief characteristics of the 16,000-tone battle-

ship No. 25, New Hampshire, as defined in the circular inviting proposals for building her, are as follows:

Length on load water-line, 450 feet; breadth, extreme, at load water-line, 76 feet 10 inches; displacement on trial, not more than 16,000 tons; mean draft to bottom of keel at trial displacement not to exceed 24 feet 6 inches; total coal bunker capacity, about 2350 tons; coal carried on trial, 900 tons; feed water carried on trial, 66 tons; hull of steel throughout; speed 18 knots, with a premium for increase and a penalty for decrease, the vessel to be rejected or accepted at a reduced price, if it falls blow 17½. The armament is as follows:

The main battery four 12-inch B. L. rifles in pairs, in two electrically controlled, balanced, elliptical turrets, on the center line, one forward and one aft, each with an arc of fire of about 270 degrees; eight 8-inch B. L. rifles in pairs, in four electrically controlled, balanced, elliptical turrets, two on each beam, at each end of the superstructure; twelve 7-inch B. L. rifles in broadside, on pedestal mounts on the gun-deck behind 7-inch armor, each gun being isolated by splinter bulkheads of nickel-steel of from one to two inches thick; forward and after guns arranged to fire right ahead and right astern, respectively; other 7-inch guns to have the usual broadside train. The guns of the secondary battery in commanding positions, having a large arc of unobstructed fire, and protected wherever practicable, as as follows: Twenty 3-inch, 14-pounder, rapid-fire guns, twelve 3-pounder semi-automatic guns, four 1-pounder semi-automatic guns, two 3-inch field pieces, two machine guns, caliber .30, and two automatic guns, caliber .30.

All the 7-inch guns are so arranged that their muzzles train inside the line of the side armor, thus leaving a clear and unobstructed side when it is desired to go alongside a pier or vessel. Arrangements will be made whereby the 3-inch guns on the main deck can be quickly and conveniently dismounted, housed, and secured; all dismounting gear to be supplied by the contractor. Four torpedo tubes and accessories will be installed, two each in forward and after submerged torpedo rooms.

The hull is protected at the water-line by a complete belt of armor, 9 feet 3 inches wide, having a uniform thickness of 9 inches for about 285 feet amidships, gradually decreased to 4 inches at the stem and stern. The lower casemate armor extends to abreast the 12-inch barbettes and reaches from the top of the water-line belt to the lower edge of the 7-inch gun ports on the gun deck, and is 7 inches in thickness, the athwartship bulkheads at the ends of this casemate being 7 inches thick. The casemate armor around the 7-inch guns on the gun-deck is 7 inches thick and the splinter bulkheads are from 1 to 2 inches thick. The protection of 3-inch guns is nickel-steel 2 inches thick. The upper and lower casemate athwartship armor extending from the shell plating to the 12-inch barbettes is to be 7 inches thick throughout. The 12-inch barbettes extend from the protective deck to about 4 feet above the main deck, and consist of 11 inches of armor in front 7½ inches in the rear above the gun-deck, and 6 inches between berth and gun-decks. The athwartship and barbette armor will not have any special framing, the connection of the armor to the decks being sufficient. The 12-inch turrets will have a front plate 12 inches thick, rear plate 8 inches thick, and top plates 2½ inches thick. The 8-inch barbettes will be 6 inches thick in front, and 4 inches thick in rear, with the upper tube 3¾ inches thick, and the lower tube 3 inches thick. The 8-inch turret front plate will be 6½ inches thick, the rear plates 6 inches, and the top plates 2 inches thick. The conning-tower will be 9 inches thick, door 6 inches thick, signal tower 6 inches thick. An armor tube 36 inches in diameter will extend from the base of the conning-tower to the protective deck, and will be 6 inches thick throughout. One torpedo directing station, 5 inches thick, will be fitted near the conning-tower. The directing station for after torpedo tubes will be located in the signal tower. Teak backing of a minimum thickness of 3 inches will be fitted behind all sides and 12-inch turret armor; 2 inches of backing to be

fitted behind the 8-inch turret armor; other armor will be fitted without backing. There is a complete protective deck extending from stem to stern, the deck being flat amidship but sloped at the sides throughout, and sloped at each end. It will be built up of 20-pound plating throughout, with nickel-steel forty pounds on the flat, except it will be eighty pounds forward and abaft 12-inch barbettes over magazines, and of 100 pounds on the slopes.

The engines will be of the vertical twin-screw four-cylinder triple-expansion type, of a combined I. H. P. of 16,500, and arranged for outboard turning propellers when going ahead. The steam pressure will be 250 pounds. The stroke will be 4 feet. The cylinder diameters will be sufficient for the required I. H. P. at about 120 revolutions per minute. Each engine will be located in a separate water-tight compartment. There will be twelve water-tube boilers, placed in six water-tight compartments. The type of boiler will be as approved by the Bureau of Steam Engineering. There will be not less than 1100 square feet of grate and not less than 46,750 square feet of water-heating surface. The working pressure will be 265 pounds. The length of grates will be about 6 feet 9 inches. There will be three smokepipes, each 100 feet high above the base line.

Water tanks for potable water will be provided for a capacity of 8000 gallons forward and 7000 gallons aft, and gravity tanks 2000 gallons. The vessel shall be lighted throughout by electricity.

With the exception of the auxiliaries operated by steam, all power will be electric. There will be thirty-three blowers for forced ventilation with a capacity of 104,00 cubic feet a minute. The capacity of the coal bunkers is 2350 tons. The vessel will be fitted as a flagship to carry forty-one officers, 815 men and sixty marines. The two steel masts will be arranged for wireless telegraphy. There will be one signal yard on each mast, a searchlight platform forward and aft, with a lookout platform on foremast, and approximately thirty-five sliding water-tight doors and six armor hatches, working on an approved system by power.

The following is the summary of weights to be carried on trial: Guns, mounts, magazine equipments, etc., 1,063.10 tons; ammunition, two-thirds cruising supply, 405.50 tons; steam engineering complete, not to exceed 1500 tons; engineering stores, two-thirds full supply, 26.67 tons; reserve fresh water for steaming purposes, 66 tons; coal, normal supply 900 tons; boats and outfits, 51.17 tons; masts and spars, 31.09 tons; equipment complete, 359.68 tons; miscellaneous stores and water, two-thirds full supply, 81.32 tons; provisions, clothing, and small stores, two-thirds full supply, 144.25 tons; officers, crew and effects, 109.85 tons; total protection, 3935.23 tons.—*Nautical Gazette.*

The battleship Nebraska was successfully launched at Moran Brothers' shipyards, Seattle, Wash., on October 7. An interesting feature of the day was the presentation of a check for $100,000 to Moran Brothers by the citizens of Seattle by way of bonus and as a mark of appreciation of their enterprise in establishing works in that city capable of turning out battleships. Eighteen years ago these brothers opened a little machine shop, 10 by 15 feet, on the water front, for the purpose of repairing the machinery of small craft. To-day their plant covers 5 acres.

The Nebraska is the first battleship constructed on the Pacific Coast north of San Francisco. She is a sister ship of the Georgia, Virginia, Rhode Island and New Jersey. Her cost is $3,733,600. The ship has a displacement of 15,000 tons; length, 441 feet 3 inches; beam, 76 feet 2½ inches; draft, 23 feet 9 inches; speed, 19 knots; indicated horsepower, 19,000; engines, two four-cylinder triple-expansion; boilers, 12 water tubular. Her main battery consists of four 12-inch guns, eight 8-inch and twelve 6-inch guns.—*Iron Age.*

The new armored cruiser Colorado, built by the Wm. Cramp & Sons Ship & Engine Building Co., at Philadelphia, made her trial trip on the

Cape Ann course off the Massachusetts coast on October 24, with a general average of 22.27 knots to her credit. At times the swift vessel steamed along at nearly 23 knots, developing 27,000 horsepower, or 4000 more than was required. Final corrections, yet to be worked out by the trial board from data furnished by the several stake boats anchored along the route, may bring about some slight alteration in the Colorado's figures, but those given are approximately correct, and it is not likely that the final showing will appreciably affect them one way or the other.

The boilers, which are of the Niclausse type, and thirty-two in number, have entirely justified themselves, not only in steaming freely and economically, but in furnishing more steam than the engines could work off. Under the conditions of the trial the pressure at the engines was not allowed to exceed 250 pounds, while the pressure at the boilers was limited to 300 pounds. The maximum number of revolutions was 131, the average being 128.

In the turning "figure eight" and other manœuvering tests, the ship gave splendid satisfaction, particularly in the complete turn, which she made in a circle the diameter of which was a little less than twice the length of the cruiser.

The Colorado is 502 feet on the load water-line, 69 feet 6.5 inches extreme breadth, and at 24 feet 1 inch draft displaces 13,680 tons of water. Of the sister ships to the Colorado, the Pennsylvania is being built at the Cramp yard, the California and South Dakota at the Union Iron Works, San Francisco, and the Maryland and West Virginia at Newport News.—*Nautical Gazette.*

Orders have been sent to the New York Navy Yard for the construction of one of the new colliers, intended to accompany a fleet on a cruise. Two colliers have been ordered, the second is to be built at the Mare Island Navy Yard, on the Pacific Coast. Each will be 450 feet long, and will have a carrying capacity of seven thousand tons. They will have a speed of 16 knots, and will each cost $1,250,000. The names will be Ontario and Erie.—*Nautical Gazette.*

PLANS FOR SCOUTS.—In the three scout cruisers which Congress authorized last spring the United States navy will have a type of unique and extremely useful warship. Secretary Morton has just approved the draft of chief characteristics, and these will be sent out to contractors who desire to bid for the contracts for these ships—the Salem, the Birmingham and the Chester.

The scout cruisers will each be 420 feet long, 45 feet in breath and 3750 tons displacement on trial. They must make 24 knots speed on trial, and will carry twelve 3-inch guns and two 21-inch submerged torpedo tubes. The government specifications will call for 16,000 horsepower reciprocating engines with twin screws, but alternative propositions will be entertained for turbine engine installation on at least one vessel, the navy being anxious to test this system of propulsive machinery.

The length of the machinery space will be protected by inclined nickel-steel deck 1.5 inch thick and vertical steel protective deck 2 inches thick. There will be at each end a nickel-steel bulkhead 1 inch thick. The steering gear above the water-line will have nickel-steel protection 2 inches thick on sides and 1 inch on top. The scouts will be fitted with four ammunition hoists for the 3-inch guns. Accommodations will be provided for one commanding officer, ten ward-room officers, five warrant officers and 368 men. The ships will carry reciprocating engines with about 16,000 horsepower. They will carry 3000 rounds of 3-inch ammunition, and eight Whitehead torpedoes, 21 inches in diameter, larger than any Whitehead torpedo now in use.

It will be the duty of these ships to scout far out at sea to gain sight of attacking fleets. They have not as much speed as torpedo destroyers, but will be able to keep the sea better. Service on them will be difficult and

COMPARISON OF CONNECTICUT OF OUR NAVY WITH LARGEST BATTLESHIPS OF OTHER NAVIES.

	England. King Edward VII.	U. S. Connecticut.	France. Patrie.	Germany. N. Class.	Russia. Borodino.	Japan. Kashima.	Italy. Benedetto.
Length	425 ft.	460 ft.	489.5 ft.	400 ft.	397 ft.	455 ft.	426 ft.
Breadth	78 ft.	76 ft. 10 in.	79 ft. 3 in.	72 ft.	76 ft.	78 ft. 2 in.	78 ft.
Mean draught	26 ft. 9 in.	24 ft. 6 in.	27 ft. 6 in.	26.9 in.	26 ft.	26 ft. 7 in.	27 ft. 3 in.
Displacement	16,350 tons	16,000 tons	14,870 tons	13,200 tons	13,666 tons	16,400 tons	13,427 tons
Men	800	786	708	627	750	(?)	(?)
Guns	4 12-in.	4 12-in.	4 12-in.	4 11-in.	4 12-in.	4 12-in.	4 12-in.
	4 9.2-in. in tur.	8 8-in.	10 7.6-in.	12 6.7 in.	12 6-in.	4 10-in.	4 8-in.
	10 6-in.	12 7-in.	8 4-in.	22 3.4-in.	20 3-in.	12 6-in.	12 6-in.
	14 3-in.	20 3-in.	16 3-pounder	12 1-pounder	20 3-pounder	12 12-pounder	16 3-in.
	14 3-pounder	12 3-pounder	2 sub. tubes	6 sub. tubes	8 1-pounder	3 3-pounder	8 3-pounder
	4 18-in. sub. tubes	8 1-pounder	2 above	1 above	2 sub. tubes	5 sub. tubes	2 1 pounder
		2 3-in. field			2 above		4 sub. tubes
		8 machine					
		4 21-in. sub. tubes					
Armor.							
Belt	9 in. to 6 in., 3 in.	11 in., 4 in.	11 in.	9 in.	9 in., 4 in., 2.5 in.	9 in.	6 in., 2 in.
Protective deck	2 in.	11.2 in. to 3 in.	3 in.	3 in.	2 in. and 4 in.	3 in.	3 in.
Barbettes	12 in.	12 in.	11 in.	11 in.	10 in.	9 in.	8 in.
12 inch turret	8	10	12	....	....	....	....
Small turrets	....	8 in.	....	11 in.	11 in.	9 in.	8 in.
Small turrets	7 in.	6 in.	5 in.	7 in.	6 in.	9 in., 6 in.	6 in.
Small battery	7 in.	7 in.	6 in.	6 in.	....	6 in.	6 in.
Conning tower	12 in.	9 in.	12 in.	12 in.	11 in.	9 in.	(?)
Boilers	B. & W.	B. & W.	Belleville	S. Schultz, 6 cyl.	Belleville	Niclausse	Belleville
Speed	18.5 knots	18 knots	18 knots	18 knots	18 knots	18.5 knots	18 to 20 knots
I. H. power	18,500	16,000	18,000	16,000	16,000	(?)	14,000 to 19,000
Coal	900 tons	900 tons	900 tons	700 tons	1250 tons	1200 tons	1000 tons and petroleum
	3000 tons	2330 tons	1850 tons	1600 tons	....	2000 tons	2000 tons
				900 tons oil			

exhausting. Quarters are provided for one commanding officer, ten ward-room officers, five warrant officers and 368 enlisted men.—*Nautical Gazette.*

ORDNANCE AND GUNNERY.

PHYSICAL EFFECTS OF MODERN GUNNERY.—Among the papers read at the last annual meeting of the British Medical Association was one by Fleet Surgeon Lloyd Thomas, which makes a strong claim upon the interest of naval officers. These "notes," as the fleet surgeon modestly calls them, have appeared in the *British Medical Journal*, and are now reprinted in pamphlet form. Twenty or thirty years ago naval surgeons did not think it worth while to study the effects of gunnery practice upon the nerves and hearing organs. To-day the matter is beginning to attract professional attention. At present there are no statistics to enable us to judge whether or no "gun-deafness" is increasing in the fleet, but it seems probable that serious injuries both to nerves and hearing are being caused afloat, and that these physical evils may be in some degree checked or alleviated. The importance of good shooting is now so fully recognized in the Royal navy that far more practice with heavy guns takes place than formerly. To every man who is not exceptionally proof against violent noise, prize firing and quarterly practice are ordeals often followed by headache or nervous strain, sometimes by temporary or permanent injuries to what the unscientific call their ears. It is a moot point, says Dr. Thomas, whether the men serving the guns inside a casemate or barbette, or those working an upper deck battery, suffer more from the effects of firing. Those on deck are more affected by the muzzle concussion, known as the "blast," those within enclosed areas by the violent shaking in the breech of the guns, which, for want of a precise word, may be termed "breech concussion."

In the judgment of Dr. Thomas, breech concussion rarely damages the drum of the ear, although it is liable to produce distinct concussions of the skull, spinal column, and the larger joints, and to give rise to headache, tongue bites, and general shock. But "blast" is a form of concussion which may have far-reaching consequences upon those within its radius, and so it is important that officers and men should avoid needless exposure to this form of shock. It is felt most acutely on the level of the muzzle, within a certain distance, and especially in advance of the firing point; but the effects of "blast" are also severely felt by those stationed above the gun level. The concussion, for example, may be severely felt on the bridge of a battleship, as officers' caps are often enough sucked clean off by the effects of the vacuum caused by these heavy explosions. An officer stationed upon the sighting-platform of a turret or barbette, commonly fitted with a movable sighting hood, is said to be specially liable to the effects of concussion, especially if a heavy gun be fired from aft forward, or vice versa. "Blast" is increased when guns are fired at low levels and over smooth surfaces, such as water, but the length of modern heavy guns is a point in favor of the gunners. Breech concussion, on the contrary, is probably less severe afloat than ashore, owing to the resiliency of the ship as a floating substance. Dr. Thomas shows that the use of telescopic sights, now fitted with india rubber eye-pieces, is attended with little risk to the eyes. Complete "gun-deafness" is stated to be quite exceptional afloat, but there is reason to believe that most gunnery officers and instructors suffer from impaired hearing, which may or may not improve in later years. The symptoms of pronounced injury to the hearing organs can usually be detected by skilled surgeons, and thus it is very important that officers and men should seek medical aid in good time. Too often, says Dr. Thomas, the injury is ignored, even when accompanied by severe pain.

With regard to the precautionary measures to be taken, this pamphlet will be found suggestive, although the author frankly admits that medical

knowledge is still very imperfect. He believes, however, that it is important to use cotton wool, wax, oil, or india rubber nipples, and indicates that these precautions are commonly neglected by the men, who think it more or less effeminate to plug the ears, or are reluctant to deaden their hearing when on duty. It is evidently worth while to experiment further with all of these proposed preventatives, and to impress upon officers and men the urgency of seeking expert treatment when pain or deafness is experienced. As most gunners know, the mouth should be kept partially open at the moment of discharge, and—this is less familiar—the muscles of the face and throat should not be kept in a state of tension. We have said enough to commend these excellent notes by Dr. Lloyd Thomas to the attention of naval men. The subject is one of vital importance to all ranks in the fleet, and merits careful study by medical officers afloat.—*Army and Navy Gazette.*

The sighting arrangement for the 7.5-inch guns of the Triumph, which has been fitted by the firm of Messrs. Vickers, Son, and Maxim, is reported as being far ahead of anything yet introduced into our navy in ships designed at the admiralty and completed in our royal or private dockyards. It is also considered to be in advance of anything yet adopted by our gunnery experts at the Gunnery School. The Triumph's sights have a cross connection, which, it has long been felt, was a great desideratum with guns on transferable mountings, and where the sights are fitted to the mountings, rather than shipped in holes in the guns, as was the old plan with all our heavier guns, and still obtains with quick-firing guns of a lighter nature than 12-pounders. The sighting of the 14-pounders of the Triumph is also an advance on our 12-pounders. Among other advantages, this system of a cross connection allows the sight-setter to work more freely on the opposite side of the gun to that on which the gun-layer is performing his functions of laying and firing the guns, and he is thus given more room and freedom for this work. At many of our guns in the secondary armament, it will, in future, be arranged that the gun-layer shall use the left sight for keeping the gun laid for elevation, and pressing the trigger when the sight comes on, while the gun-trainer, who will be an equally important gun number, will, by means of the right sight, follow the object and keep the gun constantly bearing on it so far as the training is concerned. The sight-setter will likewise be on the right of the gun, and with a cross connection between the right and left sight. The two men concerned with keeping the gun laid for elevation and training—the gun-layer and gun-trainer—will both be doing their part with their sights adjusted simultaneously, and without affecting other operations. This is a very important matter nowadays. With this combination—if the sights are not faulty—and smart gun-loading numbers, there should be further developments in rapid hitting.—*United Service Gazette.*

Since the arrival of the battleship King Edward VII at Portsmouth she has attracted a good deal of interest. Attached to each mast is a platform for the range-finder or "spotter." This is such a new feature in British battleships that their value for purposes of war has been much discussed. The general opinion is that, in the light of the experience obtained by the war in the Far East, "spotters" are not likely to prove an unqualified success. It is practically certain that the masts will be shot away early in an engagement, and the "spotter" and his instruments would thus be dislodged from their elevated position. For "the man behind the gun" to rely upon information as to range and elevation sent down from aloft would, many naval men consider, be a mistake, and that it would be better policy to train men to rely more upon themselves for these patriculars. The internal fittings of the King Edward VII have been so arranged that a cabin will be provided for every commissioned and warrant officer, though in some instances two bunks have been fitted in the cabin. Thus in this ship and those of a similar class subordinate officers only will sleep in hammocks.—*United Service Gazette.*

A rumor is in circulation in naval circles, and is believed (says a Plymouth correspondent) to be well founded, that the admiralty has decided to abolish the 4.7 and 6-inch guns in the navy, substituting for them the 9-inch gun, with which exhaustive experiments have recently been carried out. The results of these trials have, it is said, given the greatest satisfaction, the penetrative power of the new arm being very superior to that of the smaller weapons.—*United Service Gazette.*

Sir Andrew Noble, presiding at a meeting in Newcastle, of Armstrong, Whitworth and Co., Elswick Works, spoke of the lessons of the war between Japan and Russia. They must have seen with admiration the skill the Japanese had shown, and the perfection of their arrangements. All their regular battles at sea had been fought at great distances, never nearer than 3000 yards, on account of their fear of the torpedoes. The consequence was that they had to have much more powerful guns with a longer range, and they were producing guns in very large numbers at Elswick, having velocities either of 3000 feet per second or approximating thereto. Sir Andrew referred to the fact that just before the war broke out the Japanese brought two great cruisers from Ansald's, in Genoa. These were got ready after having been lying idle for some months in a week, and taken out to the Far East by their staff without mishap. Practically the whole of the armament of the Japanese navy was made at Elsworth, and they had had no complaints.—*United Service Gazette.*

Letters received from the Mediterranean squadron at Argostoli, dated the 7th inst., state that the battleship Venerable narrowly escaped destruction a few days previously, and it was only by a miracle that a terrible disaster was averted. The Venerable was engaged in long-range firing with the other ships of the Mediterranean squadron and after a round had been fired the breech of a gun was opened for the reception of another charge, when a back-flash occurred. The man who was working No. 3 was severely scorched, and the second charge which had been got ready to be placed in the gun was completely enveloped in the flash. Had this charge caught fire the flame might have communicated to the open magazine below with results that would have been appalling. Fortunately the mischief was confined to the immediate vicinity of the gun. The injured man is progressing favorably.—*United Service Gazette.*

The statement that the Japanese fired sixty torpedoes, all of which missed, in the recent naval battle, has had a most tonic effect on Whale Island and its votaries. A few months ago the torpedo, judiciously boomed, threatened to oust the gun altogether; now it is in considerable danger of being underestimated. Very possibly the sixty will turn out to be only one of those brilliant flights of imagination with which the Russians so skilfully meet the weekly sinkings of some of their ships by Admiral Togo.

The detailed story of the sinking of the Rurik proves, what most naval men suspected all along, that she was not sunk by gun-fire, but by her own crew when all hope of further fighting was past. Every gun appears to have been disabled, and this, of course, was exactly what was anticipated in the unprotected covered-in battery. No doubt the Rossia sustained losses little less grievous, but her steering gear not being injured like the Rurik's, she was able to steam away. The Gromoboi, according to the latest accounts from Vladivostock, was very little hurt. As her guns are in casemates, proof against most of the Japanese guns, this is probable enough.—*Engineer.*

There are new evidences that the war in the Far East has rehabilitated the submarine torpedo in favor, and this will be immensely enhanced by the fact that it is now obvious that not only is the range much greater,

FIG. 1

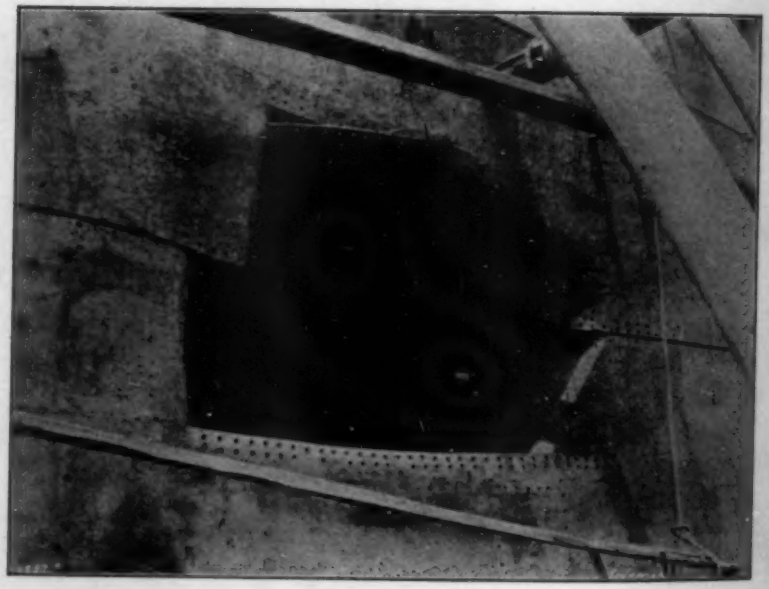


FIG. 2

but an increased rapidity of fire is possible. The adoption of the gyroscope four or five years ago resulted in so improving the accuracy of the line of fire that the range of accuracy was greatly increased—from 800 to nearly 2000 yards, the latter being attainable with the adoption of higher air pressures or cordite propelling powder. Now experiments leave little room for doubt that 3600 yards will be the probable range of the torpedoes of the immediate future. This will turn the balance in favor of the torpedo against the quick-firing gun. Many naval experts were inclined to doubt whether it was prudent to carry torpedo tubes in exposed places, as, when charged in war times, a small machine gun might cause havoc if it struck the point of the torpedo when in the tube, and it was even questioned whether, owing to the weight involved, and the uncertainty of the result, submerged tubes were worth fitting in battleships. In the later United States battleships and armored cruisers they were omitted, while in the London and King Edward VII class of the British Navy, the number was reduced to two as compared with five in the earlier ships. The same remark applies to armored cruisers. The new Lord Nelson ships will have five submerged tubes and the new United States ships will be equally powerful in respect of torpedo-firing gear. A similar tendency might be noted in connection with the vessels of European Powers. The range of the torpedo, its admitted accuracy, and its greater rapidity of fire —three torpedoes were fired accurately from one tube within two minutes on a British ship during recent tests in the Mediterranean—make this weapon of warfare more powerful than ever, and thus there is a further reason why naval engagements will, in the future, be fought with the combatants at greater distances apart. Big guns, with great energy at long range, thus become a main desideratum.—*United Service Gazette.*

THE EFFECT OF TORPEDO EXPLOSIONS.—It will be remembered how, on June 12 last, the Russian cruisers Rossia, Gromoboi, and Rurik, unexpectedly emerged from the harbor at Vladivostock, and took the offensive against Japanese shipping. On the third day out they fell in with the steamers Sado Maru and Hitachi Maru, both of 6000 tons, in the Tsushima Straits, transporting soldiers and military stores from Shimonoseki to the mainland. The Hitachi Maru, commanded by Captain Campbell, refused to stop, and was sunk by the guns of the Gromoboi; but the other vessel, disabled by gun-fire, hove to, and such of the non-combatants as desired were allowed to leave in boats. She was then torpedoed on both sides by the Rossia, and the squadron hurried northward again, leaving her apparently sinking. She remained afloat, however, and was towed home by the Hino Maru. From her appearance as she was brought into port one would hardly suppose her to have suffered very serious injuries, whereas below the water-line such huge holes had been torn in her sides that it is almost incredible how she could remain afloat at all. The first torpedo struck the vessel on the starboard side opposite the engine-room, leaving a hole, as shown by Fig. 1, 16 feet by 17 feet in the outside shell, through which, in the original photograph, the machinery in the engine-room is visible. The main condenser, the high-pressure front column, the sole-plate, the air, feed, and bilge-pumps of the main starboard engines, were smashed, the starboard pocket-bunker entirely blown up, and the ballast-pump, donkey-pump, and spare crank-shaft carried away to the other side of the ship. The screen bulkhead between the engines and boilers was also partly destroyed, and the starboard double-ended boiler was bodily shifted a few inches forward. Fig. 2 shows the effect of the second torpedo on the port side. It exploded in the cross-bunker forward of the boiler-space on that side, leaving a hole 7 feet by 13 feet in the outside shell, smashed the bunker bulkheads, and carried the port double-ended boiler some inches aft. About 150 shells are reported to have struck the vessel before she was disabled by two of them bursting in the engine-room.—*Engineer.*

Expert investigation of the circumstances attending the accident which occurred on board the Comet has demonstrated that it was owing to a broken stud forming part of the mechanism for closing the breech of the gun. This stud was found after the explosion lying on the deck of the gunboat, it having fallen out when the breech block was blown away. The discovery is satisfactory, inasmuch as it proves that the breech block was never properly secured, the use of the stud being to give the turn to the block which would have fastened it in place when the breech was closed. There being nothing visible to show that the stud had failed to accomplish its purpose, the man who operated the mechanism was unaware that the breech block was incompletely fastened. When, therefore, the gun was fired the explosion of the cartridge took effect to the rear and blew the breech block out, with the disastrous results already described. Thomas Kennedy Askew, one of the seamen hurt in the explosion, succumbed to his injuries in hospital, making a total of four deaths.—*United Service Gazette.*

The Hannibal in her last prize firing did 14 hits out of 17 rounds with a 6-inch gun. A bluejacket crew were the winners. On the average it is the marines who, relatively to their numbers, man the winning gun.—*Engineer.*

A remarkable gunnery performance has just been accomplished by the first-class cruiser Aboukir, of the Mediterranean squadron, during the annual long-range prize firing competitions. The firing was carried out under conditions identical with those that would prevail in time of war. The speed of ships firing had to be not less than fourteen knots, and the range when the order to fire was given by the umpire was unknown. At the first range, between 5000 and 4500 yards, travelling at a speed of fourteen knots, the Aboukir fired sixty rounds in less than three minutes, and scored 44 direct hits—all from the port battery. She could have fired more from some guns, only not more than eight rounds a gun were allowed to be fired. The target was the actual size of the midship portion—from the upper deck—of an averaged-sized battleship.—*United Service Gazette.*

Vice-Admiral Lord Charles Beresford recently carried out at Gibraltar a gun-layers' competition for the Channel fleet, and very remarkable shooting resulted. 6-inch guns were used and two minutes fire was allowed, each at a range commencing at 2000 yards and ending at 2600. Strict service conditions were observed, the target being of the ordinary pattern, 30 feet by 20. In all 227 rounds were fired, and the hits numbered 149. The average rounds per minute per gun was 9.45, and the hits per minute per gun was 6.2. The flagship, the Cæsar, showed the best shooting. The Ariadne, now the flagship of the North America and West Indies Station, is said to hold the world's "record" with 19 rounds and 17 hits in two minutes. One of the guns of the Cæsar in the recent competition scored 18 hits in 21 rounds. Other good "records" of the same ship in the first minute of the run were 11 rounds and as many hits, 10 rounds and 7 hits, 11 rounds and 9 hits, and 9 rounds with the same number of hits.—*United Service Gazette.*

THE VON LÖBELL ANNUAL REPORTS, 1903.

ARTILLERY MATÉRIÉL IN 1903.

Austria-Hungary.—No decided progress has been made. The commission on quick-firing field guns, etc., which has been sitting for 7 years and making all kinds of experiments, has come to no definite decision as to the merits of the Skoda and Ehrhardt systems.

Belgium.—The report gives a very short account of the new experiments made with the Krupp, Ehrhardt, St. Chamond, Skoda, and Cockerill

barrel-recoiling Q. F. field guns, which took place on the 15th September, 1903. 250 kilometers were marched, and the guns then brought into action at various ranges. The report does not give the results.

France.—New regulations for ammunition supply have been issued. According to these the 75-mm. (2.95-inch) Q. F. field gun carries in its wagons 312 rounds. The 80-mm H. A. gun 142 rounds. In the Corps Park are 355 and 185. 2 wagons of the battery carry high-explosive shell. The shields are said to be 4.5-mm. thick (.18-inch) and proof against rifle bullets at 150 yards range. The weight of the gun with limber is believed to be 1800 kilos. (about 35 cwts. 1 qr.).

A new mountain gun, designed by Captain Ducrest, of 68-mm. (2.68-inch) caliber has given good results. It carries shrapnel (13½ lbs.), common shell (double), and case shot.

Great Britain.—The new 18-pounder field artillery gun is described in the report in some detail. It is said to have the improved breech block of Colonel Deport, and to be capable of firing 29 rounds a minute and to have a muzzle velocity of 1706 f. s.

Each cavalry regiment has been given a 3.7-cm. (1.46-inch) caliber Pom-pom, of which the gun detachment (6 gunners, 2 drivers) is mounted.

Italy.—The re-armament of the field batteries with Q. F. (steel) field guns (with spade attachment), Mark 75A, 75-mm. (2.95-inch) instead of the old bronze guns is now completed. The experiments with barrel-recoiling Q. F. field guns are being continued, no conclusion having been as yet arrived at.

The batteries retain their 6 guns; their ammunition wagons are increased to 10. They carry 194 rounds with the battery. The total provision of ammunition is 500 rounds per gun. There are 90 common shell carried. The ammunition boxes of the limbers are of aluminum.

Japan.—The field artillery is armed with the 75-mm. (2.95-inch) Q. F. field gun on the Arisaka system. The fortress and siege guns are mostly new steel guns of 12-cm., 15-cm., 24-cm. and 28-cm. (4.7-inch, 5.9 inch, 9.4-inch, and 11-inch) caliber; but several of the old bronze type are still in use.

Their battleships carry, of the heavy type, 30.5-cm. (12-inch); of the medium, 25-cm. and 15-cm. (9.9-inch and 5.9-inch); of the light 7.6 and 4.7-cm. (2.95-inch and 1.85-inch). The armored cruisers have 20-cm. and 15-cm. (7.9-inch and 5.9-inch) and Pom-poms. The gunboats carry 28-cm., 26-cm., 25-cm., and 21-cm. (11-inch, 10¼-inch, 9.9-inch, and 8.2-inch) guns; and the destroyers have only light Q. F. guns.

Holland.—The final competition held in August, 1902, between the Schneider, Cockerill, Ehrhardt, and Krupp Q. F. field guns, having resulted in the selection of those of the latter system, in October, 1903, the first consignment of these guns, which will amount to 204 guns and 608 ammunitions wagons, was ordered. Of the latter, 200 were, however, to be made in Holland.

The new gun (L/30) is of 75-mm. (2.95-inch), and weighs 350 kilo. (6¾ cwt.). The carriage weighs 600 kilo. (11½ cwt.), the limber 800 kilo. (15½ cwt.). The gun in action weighs 950 kilo. (about 18½ cwt.). The weight of its shrapnel is 6 kilo. (13¼ lbs.). It carries 270 bullets, 11 grammes each. The muzzle velocity is 500 m. (1640 f. s.). Range with common, 6400; shrapnel, 5600 meters.

Russia.—The gun chiefly in use is the Engelhardt, or *"Putilow,"* M/1900 Q. F. field gun of 3-inch caliber. The carriage, which is furnished with a spade attachment, gives an awkward jump after firing. On this account, and that of the weight, it is thought no more of these will be manufactured. An improved pattern, M/1902, with longer barrel-recoil, will be selected. The heavy field artillery gun, 10.7-cm. 4.2-inch) has now been discontinued as a field artillery gun on account of its weight. Those field batteries that have not received the Q. F. field gun have the light field artillery gun, M/95, and the horse artillery gun, M/95, both of which have the spade attachment. The field artillery gun carries shrapnel, weigh-

ing 17½ lbs., and common of 15¼ lbs. The muzzle velocity with the former is 1410 f. s., with the latter, 1460 f. s.

The Siege Park has 4.2-inch guns (L/32), heavy 6-inch guns, light 8-inch and 6-inch guns, 3.4-inch, 8-inch, and 9-inch field mortars.

The navy guns are of the Obuchoff pattern, 30.5-cm., 28-cm., 22.8-cm., 20.3-cm., 15.2 cm., 10.7-cm., 8.7-cm. (12-inch, 11-inch, 8.9-inch, 8-inch, 6-inch, 4.2-inch, 3.4-inch). The heaviest Q. F. guns are the 20-cm. and 15-cm. (7.9-inch and 5.9-inch).

Switzerland.—After 10 years' experiments and a thorough study of the question, Switzerland has come to the very satisfactory decision to adopt a Krupp barrel-recoiling Q. F. field gun with steel protective shield. The simplicity and steadiness of the gun under fire, as well as its accuracy after repeated trials, led to this result.

The batteries have been reduced from 6 to 4 guns; the ammunition wagons increased to 10. The minimum number of rounds to be carried in the field per gun is 800. The gun and shield arrangement is much less complicated than that of the French. This gun has a caliber of 75-cm. (2.95-inch); the barrel is of nickel-steel and 7 feet 4 inches long, and weighs only about 6½ cwt. It fires over 3 feet 2 inches, the wheels being 4 feet 3 inches in diameter, and their track 4 feet 7 inches. The limber weighs 15¾ cwt.; firing weight 34¼ cwt. The chief ammunition is shrapnel, weight 13¾ lbs., but common of the same weight is also carried. The muzzle velocity is 1590 f. s. Some case are also used.

SMALL ARMS, 1903.

General.—The report says that experiments are continuing in most European armies with automatic rifles. Automatic pistols have been adopted by Belgian, Swiss, Bulgarian, and (partly) the German armies. The question of a practical automatic rifle adapted to *war* is, however, not so easy of solution. Officers of *war* experience are loth to give into the soldier's hands any weapon that will not remind him at each shot of the value of each round of ammunition. At the same time, they are aware of the necessity of providing him with one of a high class technically, so that he may, by using his brains, save his muscles and enhance his value by accurate shooting. The wish to entrust an ideal weapon to good shots only encounters, however, the difficulty of the huge armies of two years' service men of to-day, the result of which is that the *average* soldier is of inferior quality. This can only be balanced by the creation of standing armies of higher quality though less in quantity. This is an ideal that finds much support. Meanwhile, however, the tendency towards masses must be reckoned with, and therefore the chief arm—the infantry—must be furnished with the weapon that is technically best fitted to sustain the psychological element in war, and to discourage the waste of ammunition.

Progress with Small Arms in Individual States.

Austria-Hungary.—The repeater Mannlicher M/1895 (.315-inch) with some improvements, has now been issued to two-thirds of the infantry. The latest issue is about 2 lbs. lighter than the first. The barrel is protected by the stock till near the muzzle. It is sighted to 2600 paces. The cavalry have all received the Mannlicher carbine (.315-inch). On the whole, these rifles are said to be quite up to the constructive and ballistic requirements of the day, and are considered high-class weapons.

France.—The report gives some details of the new bullet manufactured for use with the Lebel rifle, mentioned in last year's report. It has a flatter trajectory, and inflicts severer wounds, as it flattens on impact, being of copper. It is long and pointed and lighter than the old bullet. It makes a peculiar whistling noise, which has a nerve-shaking moral effect. The rifles are now sighted to 2400 meters. The accuracy obtained with this is calculated to reduce the probable average error in judging distance by 50 per cent.

Germany.—The arming of the German infantry and cavalry with the Mauser and Carbine of 1898 is not yet completed. It was thought by some that an entirely new rifle would be introduced, as so many items in the war budget had been cut down, but in December, 1903, the war minister, General v. Einem, declared that nothing was known as to the introduction of a new rifle to replace that of 1898, and that a reliable automatic rifle was hardly to be looked for in the immediate future. Certain minor improvements were from time to time made in the rifle, which now goes by the name of pattern '98/'02. A new cartridge has, moreover, been introduced which gives a much flatter trajectory and greater accuracy.

Great Britain.—The report goes into details of the issue of the Lee-Enfield rifle to the Indian army and the volunteers. The defects of the Lee-Enfield M/'03 are set forth in the *Kriegstechnische Zeitschrift* for August, 1903, by H. Angier, an engineer in London, who describes the mechanism of the rifle in detail, which is too technical to be transcribed here. The advantages and improvements are acknowledged, but it is condemned as far too complicated. It has double as many constituent parts as the new pattern Mauser, of which there are 48 very small sections a centimeter in size or less. Though the barrel is considerably shortened the ballistic performances of the rifle are improved, but it is doubtful if this will be maintained after some use. On the whole, Herr Angier considers it an unpractical piece of patchwork, which could only be rehabilitated by the radical reconstruction of its very elements. It is the breech action he chiefly takes exception to. Many English authorities, the report says, agree with him. The *English Mechanic* says that owing to the short distance between the sight the precision of the aim and the "kick" is considerably affected. The Hythe reports of the shooting of the new rifle are all favorable, and *The Times* says that it is to be adopted. These conflicting opinions are characteristic of the state of things in the British War Office.

Holland.—The troops are armed with the 6.5-mm. (.256-inch) of 1895 (Mannlicher).

Japan.—The infantry, cavalry, and technical troops of the standing army carry the Meidji 6.5-mm. (.256-inch) rifle or carbine No. 30. Length with bayonet, 5½ feet; without, 4.17 feet; weight without bayonet, 8½ lbs.; weight of bullet, 10.3 g. (159 grains); of 1 round ammunition, 22½ g. (346 grains); weight of clip with 3 rounds, 382 gr. (13½ ozs.). The bullet has a hardened lead core with a steel or nickel mantel. The muzzle velocity is 2378 f. s.; penetration in fir at 40 meters = 2.3 meters (7½ feet). The rifle is a Mauser, but with an altered chamber. The magazine holds 5 cartridges. When empty the breech cannot be closed. The powder used is a smokeless leaf powder from Itabaski.

Norway.—The infantry carry the 6.5-mm. (.256-inch) Krag-Jörgensen rifle of 1894, cartridge of 1896.

Roumania.—This army has a 6.5-mm. (.256-inch) Mannlicher of 1893. A new rifle with a steel-pointed bullet is under trial. A new smokeless powder is being manufactured at Dudesci, and in 1903 gave good results.

Russia.—The whole of the infantry is now armed with the three-lined rifle, model 1891, of 7.62-mm. (.312-inch), and the cavalry with a carbine of the same pattern and caliber, but of 1896 manufacture.

Sweden.—The infantry has the 6.5-mm. (.256-inch) Mauser rifle of 1896.

Switzerland.—The infantry has the 7.5-mm. (.296-inch) Schmidt-Rubin rifle of 1889 and 1896; the cavalry the carrbine of 1893 of same caliber, with the Mannlicher breech action. The cyclist companies and technical troops carry a short rifle, 1889 and 1900, of the same caliber. The cadets have a special light rifle of 1897. A Captain Otter is said (*Kriegstechnische Zeitschrift*, June, 1903) to have invented an arrangement by which the soldier is prevented from aiming too high. It can be attached to any rifle.

United States.—The re-armament with the new Springfield rifle has been commenced. The magazine is generally loaded by means of a carrier, but it can be used as a single loader when the magazine is empty. It can then

be refilled singly. The attached cleaning-rod can be fixed on the rifle as a bayonet. This obviates carrying a bayonet scabbard. The muzzle velocity has now been raised to 2300 f. s. The penetration into fir at 500 yards is 18 inches and into iron at 300 yards .29 inch. It is intended to have but one rifle for all services. The trial committee, therefore, after much experiment, reported in favor of the short rifle with a barrel 24 inches long, and in June, 1903, the war minister decided on this. In December the 1st infantry regiment received it, and its isssue is now being proceeded with, 350 rifles being turned out daily.—*United Service Institution.*

LONG-RANGE GUNNERY.—The Mediterranean fleet has been engaged this month in carying out long-range firing. The importance now attached to the attainment of accurate fire at ranges varying between 4000 and 8000 yards is a fact which has almost escaped general notice, although the change that is coming over naval gunnery is most remarkable. Not long since, Captain Percy Scott was specially sent out to the Mediterranean to give his valuable and expert advice in the conduct of the new gunnery practice. This year, again, it has been decided that at least some of the heavy guns of battleships and cruisers, still in the early stages of building, shall be mounted with a view to increased efficiency in long-range shooting. That is to say, guns will command a higher freeboard than heretofore, though not, of course, all guns. Very little information has as yet been made public as to these structural changes in our future ships, nor has very much transpired as to the methods of firing. It is stated, however, by a correspondent that the Mediterranean ships have been firing at a small islet or rock, not far from Pleatea, upon which the exact representation of the hull of a battleship was depicted. The umpire-in-chief was Vice-Admiral Custance, an officer well known in the navy for his scientific qualities, and under his directions, it appears, each ship was manœuvered singly. The speed maintained is said to have been fourteen knots, and the extreme range 8000 yards. Great care appears to have been exercised in the marking and umpiring, and the points allowed for each hit varied in accordance with the range and the caliber of the gun employed. We are told, further, that the ships were worked from their conning-towers, as they would be in action.

The correspondent who briefly describes these exercises concludes with an expression of regret that the annual prize firing has not been abolished in favor of these long-range competitions. From this opinion it seems to be clear that the correspondent, who apparently witnessed the firing, is not possessed of technical knowledge. In a recent lecture at Whale Island, Captain Scott divided battle practice into four factors, each of which was declared to be of equal importance. The efficiency of the gun-layer was one of these, and it is evident that our annual prize firing is essentially a test—or should be so—of individual marksmanship. Officers and men are saying, however, that this essential test is being lost sight of through the prize firings being conducted at excessive ranges. Stories are current of the King's medals being tossed for, not because interest in the shooting has declined, but because of the impossibility—so it is said—of estimating, in present conditions, the individuality of the best shot. Indeed, it should be evident that the gun-layer must be able to witness the effect of his shot, and that he should be unaided by the "spotter."

It would be interesting to know whether our gunnery experts are in agreement with the views on long-range firing of Lieut.-Commander W. S. Sims, U. S. N., who contributes a technical article to the PROCEEDINGS OF THE U. S. NAVAL INSTITUTE. In this article the American officer lays more stress upon the importance of accurate range-finding than upon any other factor, whereas Captain Scott has stated that there are four factors, each of equal importance. At a range of six miles, writes Lieut.-Commander Sims, the projectiles of the best 12-inch guns have an angle of fall of about 11½ deg., so that the danger space of the target is 66 yards. To secure a hit, he states, the range must be known within 33 yards, and there is no range-finder that possesses such accuracy. At six miles, the

best range-finders may produce an error of 600 yards, he asserts, whilst the variation in the power of the powder charge may easily produce a further error of 200 yards. By this reasoning he arrives at the conclusion that one hit in forty-eight shots would be ideal shooting at a range of six miles. By the same methods he shows that accuracy with guns of smaller caliber is even less attainable. Now it does not appear that our ships have fired at a range of six miles, but if hits have been scored at 8000 yards it would seem that this theoretical reasoning must contain some flaw. Indeed, the importance now attached to long-range firing in our navy is a tolerably convincing proof that our naval officers do confidently expect to be able to hit a battleship considerably oftener than once in forty-eight rounds, at all events at ranges up to 8000 yards. Lieut.-Commander Sims, we notice, does not underrate the value of individual skill in marksmanship, but he insists that other causes, outside the control of the gun-layer, will produce far greater effects than personal error.—*Army and Navy Gazette.*

STATEMENT TO THE ROYAL COMMISSION ON THE WAR IN SOUTH AFRICA, BY MAJOR-GENERAL SIR G. H. MARSHALL, K. C. B., LATE COMMANDING ROYAL ARTILLERY, SOUTH AFRICA, WITH REGARD TO THE QUESTION OF USING COMMON SHELL FOR FIELD GUNS.

Re-adoption of Common Shell has been Suggested.—As some officers who have served in South Africa have advocated the use of common shells (*i. e.*, a shell which contains no bullets and nothing but a bursting charge), with field guns, I submit a statement (at the request of the Royal Commission), giving as briefly as possible the reasons for the abolition of this projectile. I feel convinced that those who have suggested its re-adoption are not aware of the numerous experiments which were carried out before its abolition was decided upon, nor of the adverse reports on it which were received from those who had had experience of the matter. I am further of opinion that those who have recommended the re-adoption of common shell have done so from a mistaken idea of what can reasonably be expected of field artillery when engaged in an offensive action, and I have dealt with this part of the question in the concluding paragraphs of this memorandum, which I have divided under the following headings:

1. Common and shrapnel shell in the 1859-77 wars.
2. Common and shrapnel shell since 1880, condemnation of the former.
3. Common shell filled high explosives.
4. South African experience.
5. Employment of field artillery.

1. COMMON AND SHRAPNEL SHELL IN THE 1859-77 WARS.

1866 War.—In the Austro-Prussian War of 1866 the Prussian artillery used common and shrapnel shell, but the general results produced by their artillery were considered by the Prussians to be most unsatisfactory, mainly, however, owing to the bad tactical use made of their artillery; in 1870 they used only a cast-iron common shell.

1859 War.—The rifled field guns used by the French against the Austrians in 1859 fired common and shrapnel shell; the value of the latter was, however, very much discounted by the fact that the time fuses used were only available for two fixed ranges, and if the enemy did not happen to be at those two ranges, the shrapnel was nearly useless, as all shrapnel shell depend mainly for their efficiency on being burst by means of a time fuse in the air fairly close in front of the enemy. The French used these same guns and projectiles in 1870, and, partly from the inferiority of their material and partly from defective training, the results of their artillery fire were incomparably inferior to those of the Germans, who had made great progress in training since 1866.

1870 War.—The effects produced by the German field artillery with their common shell in 1870 were very good, but it must be remembered that in the great battles the French made very little use of entrenchments, and in 1870 the infantry fought in comparatively dense masses, and the Germans were able to concentrate an enormous number of guns on to confined spaces densely packed with troops in the open; this was especially the case at Sedan, where the German artillery achieved perhaps its most marked success.

After 1870.—Although they were so successful in 1870, when using common shell only, when they re-armed their field artillery in 1873 the Germans re-adopted shrapnel shell, and these projectiles formed about 25 per cent of the equipment of their batteries.

With their field guns adopted in 1877, the French provided a similar proportion of shrapnel shell.

1877 War.—In 1877, the Russians had numerous field artillery, and relied mainly on common shell, though at times they got results from their shrapnel. Unlike the French in 1870, the Turks almost invariably made use of entrenchments, and even after making allowances for the faulty handling of the Russian field artillery, the futility of the Russian shell fire on the entrenched Turks was most instructive, and clearly showed that good infantry could not be driven out of its trenches by any amount of common shell fire.

Before 1877 shrapnel shell only formed 10 per cent of the equipment of the Russian field guns; after 1877 it formed about 60 per cent.

2. COMMON AND SHRAPNEL SHELL SINCE 1880; CONDEMNATION OF COMMON SHELL.

Progress Since 1880.—By about 1880 the advance of inventions and of improved manufacturing processes told greatly in favor of shrapnel shell; the higher muzzle velocities enabled smaller bullets to be used, and, therefore, a large number could be got into the shell; accurate and rapid setting metal time fuses were produced, and the introduction of steel enabled the walls of shrapnel shell to be made thinner, and their bullet-holding capacity to be increased, whilst enlarged capacity by the use of steel was of little value for common shell, as this metal was so tough that, even with the bigger burster, it did not break up like a cast-iron common shell into a large number of fragments, but only into a few large pieces, or frequently even it merely tore open, and its man-killing effect was then practically nil. The steel common shell, however, certainly obviated one serious objection to the cast-iron shell, viz., that it was not apt to break up in the gun or in flight, a failure which the weaker iron shell is inherently liable to; this is a very serious fault, as artillery must frequently fire over the heads of its own infantry, especially under modern conditions. But whilst the steel common shell was not likely to harm friendly troops, it has also been found by prolonged experiment to be practically innocuous to the enemy.

It was a steel common shell of this nature that was introduced when the re-armament of our field artillery with a 12-pounder breech-loading gun* commenced in 1885; a steel shrapnel shell with a metal time fuse (instead of a wooden one as hitherto) was also introduced for this gun, and, as an example of the increased efficiency of the modern shrapnel shell, it may be noted that the 12-pounder shrapnel (still the service projectile for the horse artillery) contains 156 bullets, whilst the shrapnel for the 9-pounder muzzle-loading gun, which was replaced by the 12-pounder, only contained 63 bullets.

As experience was gained with the new 12-pounder breech-loading gun, it became evident that the shrapnel was a more efficient projectile than the common shell under practically all service conditions.

*This gun was afterwards turned into a 15-pounder, and was the field gun used throughout the late war. A lighter 12-pounder gun was provided for the horse artillery.

Against troops in the open, probably no officer has ever suggested that modern common shell can compare with modern shrapnel, but as the failure of the common shell against other targets is perhaps now somewhat forgotten the following notes may be instructive. Many other experiments than those mentioned below have been carried out, tending to the same end.

Trials of Common Shell Against Earthworks.—In 1886, experiments with 12-pounder, 20-pounder and 25-pounder guns firing common shells, showed that a hasty field redoubt was quite beyond their power at 1200 yards range, and the ordnance committee reported that such a work was capable of offering a prolonged resistance to the fire of the heaviest pieces likely to be employed against it in the field. To open up trenches over a considerable length of crest line would be costly in ammunition, and as any damage inflicted could be very readily repaired, it seemed improbable that such expenditure would be worth incurring.

After experiments in 1889, the camp commandant at Okehampton reported that the effect of the 12-pounder common shells against earthworks of any size was worthless, and it would be a waste of ammunition to fire common shells at shelter trenches; the target they presented was very small, and, therefore, seldom hit, and such effect as was produced could be repaired with ease.

After trials against shelter trenches in 1890, the camp commandant, Okehampton, reported that common shell would cause but little loss to infantry in a shelter trench; percussion shrapnel would cause more loss than common shell, but would not be really affective, whereas shrapnel shell with time fuse were thoroughly effective against infantry in a shelter trench.

With regard to the comparative effect of common and percussion shrapnel shells against guns in pit or epaulments (range 2400 yards), he remarked that there was not much difference between the results. As regards disabling guns, it was always rather a matter of luck. In making a comparison between common shell, percussion shrapnel and time shrapnel fired at the same target and at the same range, the superiority of time shrapnel, so far as regards personnel, was very marked. As regards materiel there was, of course, a greater chance of disabling a gun with a projectile, whether common or shrapnel, which burst on striking, as the gun might actually be struck by a shell, but actually hitting a gun in a gun pit was greatly dependent on luck.

From the results of their trials, the ordnance committee in 1891 came to the conclusion that only under quite special circumstances would common shell be effective against earthworks, but that shrapnel shell fitted with time fuses were the most efficient projectiles of field artillery against troops, whether in the open or under slight cover. Even when the height of the parapet was sufficient to shelter the enemy from the fall of the bullets, time shrapnel was, of all projectiles, the most likely injuriously to affect the accuracy and steadiness of his fire, while in cases, such as those tried at Okehampton, where the protection given by the parapet was only partial, the fire of either guns or rifles would be more quickly affected by the number of hits of the shrapnel bullets on the men than by the craters made in the parapet by common shell.

Common Shell Condemned at Home.—The committee therefore recommended that all attempts to destroy earth parapets by the fire of common shell from the 12-pounder breech-loading gun should be abandoned for the future, and that the service forged steel common shell should be abandoned (since the object of its existence, the destruction of earth parapets, was given up), as soon as its place could be taken by some form of shell which would be effective for ranging, and would at the same time be an efficient man-killing projectile.

Common Shell Condemned in India.—On March 1, 1892, the Commander-in-Chief India* (Lord—then Sir F.—Roberts) wrote that he had

*This letter was countersigned by the late Lieut.-General Sir Charles Nairne, K. C. B., R. A., Inspector-General of Artillery, India.

been much struck with the inutility of common shell for field and mountain guns.* When they were made of cast-iron they rarely did any damage, but, since they had been made of forged steel, they appeared to do none at all; they did no damage to earthworks, and were far too expensive to be kept for ranging only. Some experiments had been carried out in India, using shrapnel for ranging purposes, and they had so far appeared quite satisfactory for this, and he suggested that further trials should be carried out in England. The advantage of having only one projectile, the shrapnel, on charge both to the artillery in simplifying and accelerating their effective fire, and also to the issuing departments in the field, would be incalculable.

Trials Against Brick Buildings.—In 1893, after trials with 12-pounder common shell at a field work, and at a stone building at Okehampton, the camp commandant reported that, although 60 rounds of common shell had been fired accurately at the field work, the effect was practically nil, and had shrapnel been fired instead, the material effect could not have been less, and the moral effect would probably have been greater. With regard to the practice at the stone building, he stated that it was the unanimous opinion of all artillery officers present that shrapnel shell, on account of its effect on the garrison, would have been a far more efficient projectile.

In 1893 and 1894, trials were carried out against an old coastguard house at Lydd to ascertain the relative effects of shrapnel and common shell from the 12-pounder gun against buildings.

The ordnance committee stated that the results showed that one wall was not an efficient protection against either projectile, but two walls were—the first wall in each case bursting the shells, but failing to stop either the splinters or the bullets; the second wall stopped both of these.

Common Shell Abolished.—Meanwhile, in consequence of the above quoted recommendations of the ordnance committee in 1891, and of the commander-in-chief, India, in 1892, trials had been carried out at home to see if any special projectile was required for ranging purposes, and the conclusion arrived at was that the shrapnel shell was sufficient for ranging, and that it was quite undesirable to introduce a special projectile for this purpose, and the abolition of common shell was, therefore, finally approved.

3. COMMON SHELL FILLED HIGH EXPLOSIVES.

Trials of Common Shell filled High Explosives.—Fresh attempts to make common shell a useful projectile were made when high explosives were brought into general use as shell charges (*i. e.*, about 1895); at the same time it must be noticed that opinions which have at times been expressed as to the utility of high explosive shells for field guns have been based upon little or no knowledge of the results which have been obtained with these high explosives and upon grossly exaggerated notions of their powers.

Two Types of High Explosive Shell.—Two types of high explosive field gun shell have been proposed:

1. A shell with thin walls and the largest possible burster.
2. A shell with very thick walls and a burster only sufficient to break the shell up well.

French Type.—The first type has been adopted by France, the second by Germany. One drawback of the first is that a premature explosion in the gun will inevitably destroy the gun; the second type may have a burster so small that the destruction of the gun would not be entailed; and for a

* Writing in 1897 on the subject of a new mountain gun for India, the Adjutant-General in India stated that it was now accepted that a shell to contain sufficient powder to cause an appreciably destructive effect from its bursting power alone could not be less than a 25-pounder. The 12-pounder breech loading common shell had proved of so little value as a destructive agent on impact that a common shell was not included in the existing 15-pounder equipment.

given weight of shell the second type affords more metal for the formation of splinters. These two types of shell are used in quite different ways. The French thin-walled shell is used exclusively with a percussion fuse, and is stated to be intended for the destruction of materiel and in the preparation of the attack on woods and villages.

In a high explosive shell, such as the French thin-walled one, which depends mainly for its effect on the violence of its burst, complete detonation of the bursting charge is of great importance; if detonation is incomplete, the effect approaches that of a shell filled only with powder. Complete detonation is very difficult to ensure, especially with small quantities of high explosives, unless a powerful detonator, such as a fulminate of mercury one, is used, and a fulminate detonator is far too sensitive to be allowable in conjunction with a high explosive shell. Thus incomplete detonation in medium shell, *e. g.*, 4.7-inch and 5-inch, is not uncommon, and is the rule with smaller shell, so that high explosives have not so far been found worth introducing at all for shells smaller than the 4-inch. The effect of a 12-pounder or 15-pounder high explosive shell would, therefore, be decidedly less than even its weight compared to a 4.7-inch or 5-inch shell would lead one to expect.

Trials against the old coastguard house at Lydd were carried out in 1896 with 12-pounder lyddite shells of the French type; the results were much the same as those already referred to with shrapnel and common shell, viz., that one wall gave little, two walls gave good protection.

In the operations in China in 1900, one of the new 75-mm. Q. F. French field batteries made a target of a large brick wall and gateway; two guns fired percussion shrapnel at one portion of the wall, two fired high explosive (melinite) shell at the other portion; the colonel commanding stated that the trial tended to show that against an obstacle not built of hard stones the shrapnel had as good effect as the melinite shell.

Trials Against Earthworks.—As to the general question of whether a large charge of high explosives is likely to have good effect against earthworks, a very large number of experiments were carried out from 1892-1897 in this country, principally at Lydd, and with 5-inch and 6-inch shells. In 1897 the ordnance committee, when a question of further trials was proposed, stated they thought them unnecessary; shells filled with high explosives were not considered to have any superiority over powder-filled shell for breeching earthen parapets.

The 50-pound lyddite shells thrown by the 5-inch howitzers and guns in South Africa have disappointed many officers by their results; a 15-pound high explosive shell would cause still more disappointment.

All experience has shown that the high explosive shell of the nature used in this country, in Germany and in France have little or no incendiary effect even when they burst amongst dry thatch. Shrapnel is decidedly more effective in this respect.

It may be observed here that a French field battery is only equipped with 36 (about 11 per cent) high explosive shells per gun, as against 288 shrapnel.

German Type.—As regards the German type of thick-walled high explosive shell, this projectile is intended mainly for use with a time fuse, and is meant to be burst in the air immediately over the heads of men in trenches; the angle of opening of this type of shell is, however, so prescribed that extreme accuracy both on the part of the gun and of the fuse is required in order to obtain any effect.

In 1896 trials were carried out in England with the 15-pounder breech-loading field gun, to test the value of this German type of projectile. Everything was done to ensure the utmost accuracy of fire; the fuses were specially made and most carefully set, and the difficulties of service conditions were not observed; the effect was infinitesimal, viz., one hit on the dummies behind the parapet after 50 rounds.

The ordnance committee reported that this was a poor result, and showed no trace of the special effect on troops behind cover, which had

been claimed for this nature of projectile. They considered the effect was not such as to justify the idea that high explosive time shell was an affective man-killing projectile against troops behind cover.

Messrs. Krupp's views on high explosive shells for field guns have been published in a report issued by the firm in 1898. They consider the thin-walled shell with large burster dangerous to fire, whilst, of the thick-walled shell with time fuse, they consider the effect can only be slight, as in order to obtain satisfactory results, the target must be well defined, ranging must be very accurate, the height of burst must be well controlled, and continuous careful observation must be ensured. In the field, they point out, it is seldom possible to meet all these requirements; the fragments are scattered with superfluous energy in all directions almost normally to the trajectory, and half of the weight of the shell only is effective downwards; very slight protection, such as 1-inch boards, is sufficient for cover against such splinters. Messrs. Krupp consider as fallacious the idea that the use of high explosive shell in field guns with time fuses would obviate the necessity of high angle pieces. They consider that high explosive shell should be discarded for flat trajectory field guns, but might be used for high-angle fire. They consider that it is useless to expect one sort of projectile to do what only a special sort of gun, viz., a field howitzer, can accomplish.

Of the German shell, General Rohne, a high German authority on the subject of field artillery fire, wrote in 1899: "A projectile whose use necessitates such great accuracy may be considered as of little practical use on service. I consider that the high explosive shell, to the adoption of which I personally contributed, has not given at practice all that the first trials seemed to promise, and in reality it will give still less than is now expected of it. Since the adoption of the field howitzer, I recommend the complete suppression of the high explosive shell in the field gun."

It may here be observed that the Germans possessed no field howitzer till 1900, when the 1898 model was issued; the French introduced their 120-mm. field howitzer about 1894; the Germans had, therefore, been under the necessity of endeavoring to get some searching effect from their field gun projectiles, and the high explosive shell with time fuse had been introduced for this purpose; the French, possessing a field howitzer, seem to have seen no object in adopting this latter projectile. The British field howitzer 5-inch was adopted in 1895.

A German field battery and light ammunition column carry 153 shrapnel and 28 (*i. e.*, 15 per cent) high explosive shell per gun.

4. SOUTH AFRICAN EXPERIENCES.

As to the question of the value of common shell with field guns, the following extracts from reports by officers of experience in South Africa are quoted. ("Percussion shell" mentioned in some of these reports includes all common shell. Ring and segment shell are modifications of common shell, and are used in the same way as this latter.)

Major Wray.—Battle of Dreifontein, March 10, 1900, enemy put about 40 percussion segment into a battery (Q Royal Horse Artillery); effect on personnel, nil; on material, one bar supporting pole broken.

Major Du Cane.—Near Johannesburg, the royal horse artillery batteries of the cavalry division were under heavy shell fire for some hours from Boer guns of various calibers and ranges. The shells were nearly all percussion, and the effect on personnel practically nil.

Major May.—The effect of common shell was very slight. Even the Boer 6-inch shells rarely did serious damage unless they struck a house. This was especially noticeable during the siege of Ladysmith, when many thousands of shell, chiefly common, did not kill more than one officer and 33 men, and wounded only 25 officers and 207 men. On the other hand, shrapnel was very destructive when a good burst was obtained.

Major Dawkins.—On October 30, 1899, this battery was exposed to heavy shell fire, enfilading it at a range of about 3200 yards from at least four of

the enemy's guns. . . . . The effect was remarkably slight. . . . . Most of the shell were percussion, either common or ring.

Lt.-Col. Coxhead.—The Boer artillery fire was of small account, owing to their inability to employ time shrapnel. . . . . During the four months' siege of Ladysmith my camp of 600 men and 600 horses, situated on a plain partially sheltered by trees, received its regular daily bombardments from guns of various natures, and suffered a total loss of one man wounded, one horse killed and one horse wounded. On January 6, 1900, the 53d Battery was pounded for hours by the 6-inch and other guns on Bulwana Hill, and sustained a loss of four men wounded, with no casualties amongst the horses. The 42d Battery, heavily bombarded in their gun pits all day, had no casualties. The 21st Battery, in the open plain, and fired at from three directions, front, right and rear simultaneously, had but three men wounded and 14 horses killed and wounded. . . . . The only shell worth the trouble of loading a gun with, for employment in the field, is a time shrapnel.

Major Blewitt.—The Boer 6-inch common shell were burst on every sort of ground, and fired at all ranges, from 4000 to 11,500 yards, and there can be no doubt that as a man-killing projectile they were pretty well harmless. . . . . The Boer practice with their 6-pounder percussion shell at the end of Wagon Hill was very good, but as far as I could ascertain only one officer was killed. . . . . Many of these shells burst in my battery, but no damage was done. . . . . In conclusion, I am convinced that, considering the weight of ammunition fired, with the results obtained, common shell are useless as man-killing projectiles unless they can be burst on a screen. As this includes 100-pound shells, it is needless to mention smaller calibers. The really effective projectiles are time shrapnel shells in the hands of skilled and properly trained men. . . . . Time shrapnel is probably the only effective man-killing projectile in existence.

Lt.-Colonel Hall.—The enemy's shrapnel was so bad that it caused little damage. It was also a matter of surprise to see their other shell do so little damage when they often had the range very accurately.

Lt.-Colonel Bell-Irving.—Percussion shell do very little harm at ordinary ranges, and practically no harm at long ranges.

Lt.-Colonel Williams.—Generally speaking, the effect of the enemy's artillery was insignificant. They almost invariably fired at long ranges, and generally used percussion fuses. Their segment shell is quite harmless.

Lt.-Colonel Jeffreys.—Enemy's segment were ineffective. . . . . Shrapnel holds the field as a man-killer.

Major Perceval.—Effect of enemy's fire on materiel nil, on personnel very slight. Segment shell, which was generally used, seems to have a very small effective zone.

Major.-Gen. Downing.—The enemy's common shell of all natures did no appreciable damage.

Major Scott.—The effect produced by the Boer guns was very little indeed, and, as a rule, nothing. Their shell nearly all act on percussion; this, I think, arises from their using a large number of segment shell, and also from their inability, as a rule, to manipulate time shell.

Captain Montgomery.—Effect of enemy's guns very slight. The Krupp field gun ammunition is inferior to ours. Their segment shells are useless. When fired at by our own captured guns, the effects were much more unpleasant, and the bursts more regular.

Major Home.—All Boers I have talked to say that what they dreaded most was the shrapnel.

Major Duerôt.—For field artillery, shrapnel is essentially the only projectile.

The above extracts are typical of a large number of reports that have been received; a few officers out of a considerable number recommend the introduction of common shell, but in every case the recommendation appears to have been made rather from a hope of what these projectiles might do than from any definite experience as to what they really can do.

The reports received speak strongly of the efficiency of shrapnel; against

an entrenched enemy this projectile might not at times have caused many casualties, but it was repeatedly found to keep down or altogether silence the enemy's rifle fire, or to disconcert his aim. Numerous reports show that the shrapnel fire of the field artillery was a great assistance to the assaulting infantry. A strong demand was expressed that even the 5-inch field howitzers should be given a considerable proportion of shrapnel in their equipment instead of its consisting entirely of lyddite shells.

In 1901 a committee, composed of six artillery officers who had had extensive experience of the operations in South Africa, was formed under the presidency of Major-General Sir G. H. Marshall, to report upon the requirements of field artillery equipments. The following are some extracts from their report, which deal with the question of shrapnel shell and common shell for field artillery. They stated that "one of the most important lessons demonstrated is the utter inefficiency as man-killers of common shell (even of 100 pounds in weight) fired from guns against even defined and located targets, and the efficacy of good time shrapnel under similar circumstances." . . . . "The committee have no hesitation in saying that they, with their present knowledge, consider time shrapnel shells to be the only effective and possible man-killing projectiles for horse and field artillery. Segment and heavy common shell have proved in this war, even when well aimed, singularly ineffective. It is only what was to be expected, as the efficiency of common shell as a man-killer depends on a successful combination of chances (including nature of ground on which the shell falls, angle of descent, number of fragments into which the shell may break up, and the course taken by them after they are released), which can only occur on rare occasions. With regard to the destruction of enemy's guns, the extreme accuracy required to hit them, and then in a vital part, tends to show that the smothering of a detachment with shrapnel bullets is by far the more certain and economical way of silencing a gun.

5. EMPLOYMENT OF FIELD ARTILLERY.

I think that what is at the bottom of the demand made by some officers for common shell for field guns is a mistaken conception of what field artillery may reasonably be expected to achieve. The demand appears to be founded upon a theory that field guns alone should, by their fire, be able to drive an enemy out of his entrenchments. If the enemy's infantry is good, I do not think that there is anything in the experience of war, or of the practice ground, to show that this can be done. The "Letters" by Prince Kraft zu Hohenlohe Ingelfingen may be regarded as the standard work on the subject of the employment of field artillery as far as experience went up to and including 1870. He contends strongly that field artillery may frequently be able to carry on a defensive action alone, and may unaided be able to repulse infantry attacks, "but," he continues, "in any *offensive* battle the independence of the artillery comes to an end." . . . . He endorses General von Dresky's statement, "I found it impossible with artillery fire alone to drive *good* infantry from a position." And, again, "With artillery fire alone, *good* infantry cannot be driven out from a position under cover." It must be remembered that this was the experience of the Germans when common shell was the only projectile used. The present demand for common shell is, I think, based on the assumption that these shell will strike the crest of any parapet, open up the trench, and burst inside it. A well-designed trench, however, offers little or no vertical target, and is extremely difficult to hit at even short ranges. Peace experience, a few of the results of which have been quoted above, shows that no great effect on trenches or on their defenders can be expected from field gun common shell, even if they do hit the parapets. The German experience in 1870 proved the same, and so did the Russian experience in 1877; the Turkish trenches were subjected to days of heavy continuous common shell fire, without the defenders being driven out of them, or in the least shaken; they were, on the contrary, able to repulse the Russian infantry with heavy loss. All these results, together with those obtained in South

Africa, show that it is not by common shell or other artillery fire alone, but by the close co-operation of artillery and infantry that an attack may be made successful; the infantry must force the enemy to man the trenches, and to expose themselves to fire, and when they do this shrapnel is most unquestionably an infinitely more formidable projectile than common shell; all through the South African campaign, whenever a suitable artillery position could be obtained, shrapnel has shown itself capable of keeping rifle fire in check, or of silencing it altogether; accurate rifle fire has been turned into inaccurate and unaimed fire as soon as shrapnel has been turned on to it; guns (as at Modder River) have been able unaided to maintain themselves in front of intrenched infantry at 1100 yards; at Pieters Hill, at Alleman's Nek, at Diamond Hill, at Bergendal, and on other occasions, the close co-operation of artillery, shrapnel fire, and of advancing infantry, has proved most successful, but not one single instance can, I believe, be quoted of entrenched troops being driven out of their positions by percussion shell fire, even when heavy guns have been employed. The repulse of the Irish Brigade on February 23 outside Ladysmith is an instance of a case where no good artillery position could be found to cover the assaulting infantry, who were consequently unsuccessful.

General Sir. R. Buller has reported that "the real lesson of this war seems to me to be that infantry . . . . cannot by their fire keep attacking infantry away from their position if they are during the advance of that infantry subject to a heavy fire from another direction." It is this heavy fire that field gun shrapnel can supply.

Finally, I would quote Lord Roberts' orders, issued in January, 1900, in which he states that "Unless a strong force of infantry is posted within 900 yards of the position, the enemy will not occupy his trenches, and the guns will have no target. It is a mere waste of ammunition also to bombard an intrenchment when the infantry is likely to be delayed even for a short time." It is for this nature of useless bombardment, it seems to me, that common shell is demanded; till the enemy occupies his trenches, and, by endeavoring to check the attacking infantry, shows himself, no nature of field gun is of value; as soon as he does show himself shrapnel is unquestionably the only projectile to use.

MISCELLANEOUS.

NAVAL ACADEMIES OF RUSSIA AND JAPAN.—In order to understand the fighting strength of the Russian and Japanese navies, one must know the manner and extent of the education of the officers of the two fleets. The *Navy League Journal* gives an interesting sketch of the naval academies of Russia and Japan, and by way of introduction states that the average age of the admirals of the two fleets is fifty-nine years for Russia, forty-nine for Japan, and the ages of the captains of the battleships are fifty-two and forty-six, respectively. Continuing, the *Journal* states:

The Russian Naval Academy is at St. Petersburg and was founded about 200 years ago.

Examinations for entrance are held once a year, in August, and are open to all boys between the ages of 12 and 14 who are the sons of naval officers or noblemen. About 100 cadets enter each year. The course at the academy is six years. During the first three years the cadets receive only an ordinary academic training, nothing professional being taught. The professional education begins with the fourth year. It consists of theory on shore during the winter and training afloat in masted ships during the summer. The school year begins on September 15 and ends on May 15. Three cruises are made dealing with general practical work, and a fourth of four months' duration deals especially with navigation. Before graduating there are two examinations: first, a theoretical one, held at the school in the spring, and second, a practical one, in the fall on board ship after the final four months' cruise. Cadets who pass both examinations are promoted to

mitchmen—that is, ensigns. To be promoted to this grade it is also necessary for the cadets to have spent two years on board ship during their time at the academy.

The corps of cadets is divided into six companies, each class forming a company. Of the cadets who enter each year, a certain number—those who pass best—are supported by the government. For instance, in 1901 there were only 75 vacancies; the first 60 cadets were admitted at the expense of the state; the remainder had to pay about $175 a year. As soon as a boy successively completes the first three years and begins his professional studies, payments from home cease and the cadets are then no longer in any way dependent upon their parents or guardians.

Japan's navy is about forty years old. She then had one or two vessels. She realized immediately the necessity of training a corps of officers and sent young men to England and this country. The first Japanese midshipman entered Annapolis in 1869. One of her admirals, Uriu, in command of the squadron which fought the action off Chemulpo in February, graduated from Annapolis in 1881.

The Japanese Naval Academy is at Etajima, an island in the Inland sea, about ten miles from the naval port of Kure. It was founded about 1870.

Entrance examinations are strictly competitive and open to all male subjects between the ages of 15 and 20, excepting those married, those who have undergone any serious punishment, and bankrupts. Every year the secretary of the navy publishes the names of the cities where the examinations will be held and gives the general character of such examinations. Last year 1995 cadets presented themselves and 180 entered the academy. The number entering each year varies, but is about 200. The course is three years, each year commencing with the 10th of January and ending with the 9th of next January. The summer vacation is from July 21 to September 10, and the winter vacation from December 21 to January 9. Examinations are held monthly, semi-annually and annually. Cadets are not marked on their daily recitations, but their examination marks fix their standing. To be satisfactory, cadets must make an average of 50 per cent in all general branches and 50 per cent in each technical branch. The course of instruction resembles that in Annapolis in a general way, professional subjects being taken up from the start. There are three training ships and five launches attached to the academy, and part of the vacation is devoted to drilling on board the ships. When the cadets have passed the final examination, they are promoted to midshipmen. They are then transferred to a training squadron of three modern cruisers commanded by a rear-admiral. This squadron cruises for eight months in home and foreign waters, and its officers are generally composed of those who were instructors at the academy. During this cruise the admiral transfers his flag several times so as to teach the midshipmen the duties on flagships. After this cruise the midshipmen are distributed to the vessels of the regular fleet as sub-lieutenants, and perform the duties of junior officers, being closely watched by the captain, and put under the charge of a very competent officer for particular instruction. The entire cost of maintenance of the cadets while at the academy is borne by the government.

It is worth while to give a translation of three rules taken from the academy regulations: "The education shall aim to develop cadets morally, physically an intellectually; of the moral education, special attention shall be given to the encouragement of firmness and resoluteness. The object of moral education is to inculcate, in accordance with the Imperial Rescript and the natural character of Japan, a spirit of loyalty and love of country. To infuse this spirit, the instructors shall themselves be examples to the cadets, and frequently give the cadets illustrations from ancient and modern history. The object of physical education is to form vigorous officers able to perform the hardest tasks of naval service. For this purpose attention shall be paid to health, and encouragement shall be given to active exercises."—*Marine Engineering.*

THE NEW CUNARD TURBINE STEAMERS.—Among the nautical exhibits in the Transportation Building the most complete is that of the Cunard Steamship Company, which consists mainly of a set of handsome models illustrating the progress of the shipbuilding art, as shown by the various transatlantic steamships which have been turned out during the sixty-five years of the company's operations. The group of models is flanked by a large diagram which shows the progressive development in size, horsepower and speed of the ships during the period under consideration. The smallest model is that of the historic Britannia, the pioneer vessel of the company. This little craft, which was launched in 1840, was 200 feet in length (which by the way is only about 50 feet longer than the racing yacht Reliance), 34 feet 4 inches in beam, 24 feet 4 inches in molded depth, and she had a gross tonnage of 1154 tons. With an indicated horsepower of 440 she was capable of making a speed of 8.5 knots an hour. It is not our intention here to trace the development of the boats through the age of wood, which lasted till 1852, or through that of iron, which ran from 1852 to 1879, when the first steel vessel of the company made its appearance as the Servia, of 9900 tons and 16.7 knots speed. The three largest models are placed in the line ahead and they represent the Lucania, of 625 feet length and 22 knots speed, the Caronia, one of the two new boats now under construction, to be placed on the line in 1905, and between them is the model of the new 25-knot turbine steamers. Of the two sister ships of the Caronia type, one is to be propelled by reciprocating engines, the other by engines of the turbine type; and as the two vessels are to be identical in everything except their motive power, an excellent opportunity will be given to determine the exact relative fuel efficiency of the two systems, to say nothing of the comparative data that will be obtained bearing upon the question of oil consumption, wear and tear, and the cost of attendance. These two vessels are to be 650 feet in length, 72.4 feet in beam, and 43.9 feet in molded depth; the tonnage will be 21,000, and with 21,000 horsepower they are expected to make a speed of between 18 and 19 knots an hour.

Of course the model that attracts most attention is that of the new 25-knot, 40,000-ton turbine steamers. The fact that the surrounding models are built to the same scale renders it possible to make an instant comparison, at least in point of length and bulk, between the new ships and the other large vessels. The result is striking, for the Lucania, for all her length of 625 feet, looks positively a small vessel in comparison. The most notable features in the turbine steamers are the great height of the freeboard, the great diameter and lofty reach of the smokestacks, and the vast unbroken sweep of the upper decks. For reasons which can well be understood in this age of keen competition, the company has not seen fit to place upon the placard of this model any of the dimensions, but it is probable that when the vessels are launched their length will be found to run close to 800 feet, their beam to about 88 feet, their draft to 35 feet, and the displacement will be not short of 40,000 tons. By studying the model it will be seen that the side plating of the vessel has been carried up one deck higher than has been common in previous large ocean liners, thus adding about ten feet to the freeboard, and giving three lines of portholes. From abreast of the forward smokestack to the bow the plating is carried up yet another deck, thus providing a flush forecastle deck extending from 50 feet or more aft of the bridge clear to the bow. There is, therefore, no well to become flooded with water when the ship is driving into a head sea. The freeboard at the bow must be fully 45 feet and amidships it cannot be less than 32 to 35 feet. Above the water line there are six decks, three of them contained within the hull proper, and the other three being carried on extensions of the framing and affording vast promenades open to wind and weather. The smokestacks, which reach about 170 feet above the keel, are even larger than those of the Lucania, which are 21 feet in diameter. They are elliptical in cross section, and on the longer axis they measure 31 feet.

The horsepower necessary to drive this vessel at 25 knots an hour and provide a sufficient reserve for heavy weather will be not less than 75,000 and possibly more. It will be divided between four shafts. The outer propellers extend through the hull at a considerable distance forward of the stern post while the inner pair of propellers are located in the usual position near the stern post. This division of the power between the four shafts will, of course, conduce greatly to the security of the ship, and will make sure that, even with one propeller disabled, she will be good for something over 22 knots an hour. It is expected that these vessels will be in service in the season of 1906.—*Scientific American.*

PROGRESS REPORT ON THE PANAMA CANAL.—*Washington, D. C., October 18, 1904.*—The Panama Canal Commission, which recently returned from the isthmus, has decided to defer a settlement of the important question as to whether the canal is to be built by contract or by day's work, under government supervision, until a sufficient amount of work has been performed under the commission's engineers to form the basis of an accurate estimate of the cost of excavating and other engineering operations. The question will probably not bet settled before next March.

Admiral Walker, chairman of the commission, has prepared a memorandum giving the present status of the work on the canal and the plans thus far made for its prosecution. A portion of this memorandum, which will be of interest to manufacturers and contractors who are following these developments, is appended:

"We have now between 200 and 300 engineers and others sent down from the United States engaged in the engineering and construction work and upon sewerage and water supply, with a force of from 1000 to 1200 laborers, etc. This does not include the sanitary force nor the force of the governor of the zone, or the material and supply department.

"An engineering force in charge of sewerage and water supply for Panama and Colon is now constructing a reservoir to the valley of the Upper Rio Grande, which will furnish a minimum supply of 2,000,000 gallons a day for the city of Panama; also a distributing reservoir for the city of Panama at Ancon; also making surveys, plans and estimates for a sewerage system for the city of Colon and surveys and estimates for establishing official grades for the streets of Panama.

"Plans are being prepared for the construction of a harbor at Colon, for which tenders will be asked early in December. Plans are also being prepared for the construction of wharves and docks at Colon, and necessary warehouses to handle and protect the material which will be shipped to the isthmus.

"The average amount of material taken out of the Culebra cut has been from 1000 to 1500 cubic yards a day, and, when everything favors, at times 2000 cubic yards; that is with the use of the old French machinery that is available. We have bought three modern steam shovels—one that has gone down to the isthmus, and two others that will follow shortly, for use in the Culebra cut. They will increase the output fivefold. We have also opened bids for 11 more steam shovels.

"A machinery department has been organized, and the old shops of the French company are being put in repair and operation, and the old machinery supplemented by new and modern machinery, in order that the repairs to cars and equipment may be properly taken care of. A building department has also been organized, under a supervising architect, who has charge of repairing the existing buildings, of which there are 200 along the line of the canal—warehouses, storehouses, barracks, etc.—and planning and superintending the construction of such additional buildings as may be necessary.

"When we took over the work the French were removing about 25,000 cubic yards a month. We removed in August about 37,000 yards, but in September a smaller amount, because the weather was bad and there were some bad slides, which broke up some of the excavators. We cut the unit

cost of excavating material in July to 60½ cents per cubic yard; in August to 50½ cents per cubic yard. During the time Major Black was in charge there the French cost was 79 cents per cubic yard. One month we cut the cost down to 45 cents, but that was due to there being no rock excavation." —*Iron Age.*

A substance called petrolignite is being adopted as a material for the decks of ships, being under trial in the French and German navies, as well as the British service. It is prepared from sawdust, mixed with certain minerals, and formed into slabs, under high hydraulic pressure, and has been placed upon the market in England. Its valuable properties are that it is non-inflammable, and is not slippery when wet. It is said that it will not harbor germs, and that in tropical climates it will resist the attacks of white ants. It is very hard, and like hard wood, can be worked with tools into any shape.—*Iron Age.*

The four after boilers of the battleship Prince George, now undergoing repairs at Portsmouth, are being fitted to burn either oil or coal, there being two sprays to each furnace for the distribution of the oil. Tanks will be constructed in the double bottom to take 400 tons of oil similar to those at present fitted to the battleships Mars and Hannibal. The oil will, it is understood, be auxiliary fuel, to be used in case of emergency, such as the coal having run short or steam being quickly required. Similar fittings will, it is believed, be supplied to other battleships as in due course they come to hand for repairs as opportunity offers. It is also understood that the tanks of the Mars and the Hannibal will be enlarged in order that 400 tons of oil may be carried in place of the present amount of 200.

Comparative trials between destroyers are taking place daily in the Channel. As far as can be ascertained the experiments up to the present time have been in favor of oil fuel, its general handiness and utility having proved superior to coal. A full pressure of steam can be raised with oil in less than half the time required with coal. Other advantages are its greater cleanliness, the furnaces not becoming choked as they do with coal, and the smaller number of men required in the stokehold. The relative cost of the two fuels appears about equal. The only possible danger likely to occur would be the igniting of the oil, as happened lately on board the Spiteful; but this would not take place in a vessel specially built for oil fuel, the Spiteful having been merely adapted for the purpose.—*United Service Gazette.*

The discussion on the respective merits of oil fuel and coal as combustible material for use in warships has received an important addition this week in the shape of comparative trials which have resulted, according to usually well-informed authorities, "in favor of oil fuel, its general handiness and utility having proved superior to coal." In other ways, also, oil has demonstrated its superiority in the trials which have recently taken place between the torpedo-boat destroyers Peterel and Spiteful. The time required by furnaces using liquid fuel to raise a full pressure of steam is about half that required by furnaces burning coal, and the cleanliness of oil as compared with coal is apparent in the absence of ashes and the consequent impossibility of the furnaces becoming choked, while the relative cost is apparently the same. There are, of course, dangers attendant upon the use of oil, sudden ignition, as was recently demonstrated in the Spiteful, being not the least of these; whether this danger would be present in any large degree in vessels specially constructed for the consumption of liquid fuel is a point upon which opinion is divided, but it is certain that the use of oil would have a far-reaching effect on naval architecture. The Prince George, which is under repair at Portsmouth, is having her four after boilers fitted to burn either oil or coal, there being two sprays to each furnace for the distribution of the oil. The Mars and Hannibal are already fitted in this way, and it is reported that other battleships are to be fitted

with the double form of fuel consumption as opportunity occurs. At present the tanks in the double bottoms of the Mars and Hannibal only hold 200 tons of oil, but they are to be enlarged to double that capacity, and 400 tons will be carried by all vessels fitted for oil fuel in the future.—*Army and Navy Gazette.*

The work of taking in coal on board the ships of the Channel Fleet commenced on Saturday week, after the arrival of the fleet at Portsmouth, and was continued daily (Sunday excepted) until the following Tuesday. The whole fleet (with the exception of the cruiser Theseus, which arrived at Portland in advance of the ships and commenced coaling on the previous Thursday) started at 6.30 on the Saturday morning and the work was completed at 1.15 on the Tuesday afternoon. The total quantity of coal taken in by the twelve ships was 13,089 tons, and eight colliers were employed for the work. The results are appended: Cæsar, 1368 tons, at an average of 152 tons per hour; Mars, 1000 tons, at an average of 142.8 tons; Jupiter, 1442 tons, average 102.4; Majestic, 1529, average 94.6; Magnificent, 1089, average 90.75; Doris, 656 (89.4); Hannibal, 1022 (85.2); Victorious, 1465 (79.5) (in this case the Temperley apparatus was out of action for 3¼ hours); Endymion, 1030 (73.6); Illustrious, 1237 (72.7); Hermes, 570 (63.3); Theseus, 681 (61.4).—*United Service Gazette.*

Pointing out that all forts, floating protection and marine defenses of our naval bases, arsenals and coaling stations are under the control of the War Office, Lord George Hamilton says in a letter to the *Times:* "Under this system we have built forts which for twenty years after their erection were useless for want of guns. . . . . If we were at war to-morrow with a great naval European power, our fleets would be mobilized and at their anchorage ready for action long before the defenses essential for their protection would be in working order. . . . . The army cannot effectively perform this work," adds Lord George.—*United Service Gazette.*

THE experiments with submerged coal, which commenced at Portsmouth about eighteen months ago, have been resumed. In May, 1903, five crates of coal, each holding two tons, were sunk in No. 2 basin, and a similar quantity was placed at the coaling point in small heaps, covered with tarpaulins. Six months ago some of the submerged coal was raised and burnt, in conjunction with similar quantity of that which had been kept on land, and the results showed that the submerged coal had greater calorific qualities. A similar test is to be made on the present occasion.—*Engineer.*

TRAINING AT SEA.—The first-class cruiser St. George is to be withdrawn from the South Atlantic station, where she has been acting as senior officer's ship, and appropriated for the training of youths at sea, succeeding the present seagoing training ships Cleopatra and Calliope. The St. George will arrive at Portsmouth on the 19th inst., and the Cleopatra will be paid off at Devonport and the Calliope at Portsmouth as soon as the St. George is ready for sea. The latter becomes a Devonport ship for manning and other purposes.

This is a further step in the new system, introduced by the admiralty some time ago, for the training of boys at sea. It will be remembered that last year the cruiser Iris was commissioned at Portsmouth as a seagoing tender to the training-ship St. Vincent, and this year the cruiser Medusa was commissioned as tender to the Impregnable, at Devonport, while about the middle of next year the cruiser Medea will become a tender to the land training establishment in course of erection at Harwich. It will thus be seen that all the stationary training establishments have now, or will have, seagoing tenders. We are informed, however, says the *Western Morning News,* that Sir John Fisher, who has gone to the admiralty as First Sea Lord, with the intention of reforming several branches of the

service, is responsible for the order by which the St. George is to take the place of the Cleopatra and the Calliope, and thus improve the whole of the training service. It is thought, also, that the Northampton, to which the Cleopatra and Calliope are tenders, will shortly be paid off and a modern ship commissioned in her place. If this is so, the system of training boys at sea in sailing vessels will be completely abolished, as although the Northampton, Cleopatra and Calliope are engined, they are also fitted with sailing gear, which is very largely used.

The Cleopatra, which was built at Glasgow in 1881, is fitted with engines made by Messrs. Humphreys & Co., and is capable of attaining a speed, when under steam, of 13 knots an hour. The Calliope was built at Portsmouth in 1886, was engined by Rennie, and has a speed of 14.6 knots an hour.

Compared with these two vessels the St. George is a comparatively modern ship, having been launched at Hull in 1892, and completed for sea two years later. Her engines are by Maudslay & Co., and her contract speed is 19.7 knots. Her armament consists of two 9.2-inch guns, ten 6-inch, twelve 6-pounder, and several smaller guns, as well as four torpedo tubes, two of which are submerged. She is also well armored. Compared with the training now received by boys on the Cleopatra and Calliope, from a gunnery point of view alone, the advantage gained by the commissioning of the St. George will be inestimable, as on the present vessels the principal guns are only 6-inch and 5-inch. The St. George will be the most modern of the ships employed in the training of youths on her being attached to that branch of the service, as the Iris was launched in 1880; the Medea and Medusa in 1888. She will also be the most heavily armed.

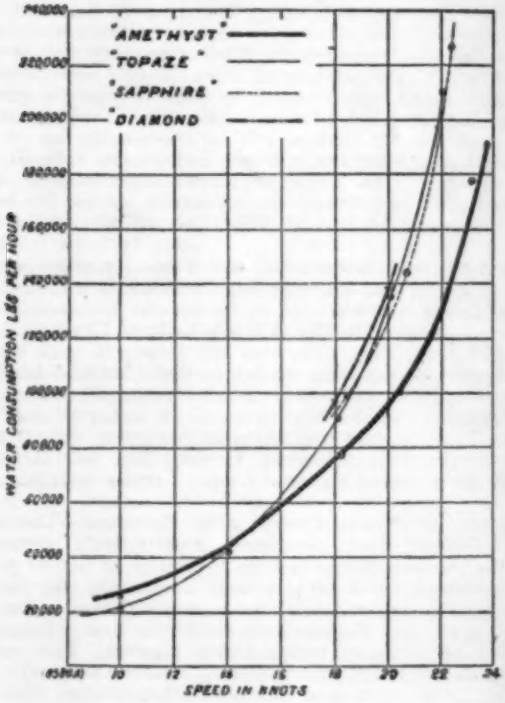
The armored cruiser Northampton, which has for some years past done good service as a seagoing training-ship for boys, is to be relieved by the Hawke. The change is a wise one, as the Hawke is a more modern vessel than the Northampton. The Hawke was built at Chatham and was first commissioned in May, 1893. She was last employed with the home fleet.

The cruiser Aurora, seagoing tender to the Britannia, training-ship for cadets at Dartmouth, is to be paid off at Devonport on the 18th instant, and on the following day the Highflyer will be commissioned in her place. The Highflyer has this year undergone an extensive refit at the works of the Fairfield Shipbuilding Company, Govan. She was last employed as flagship on the East Indies Station.—*United Service Gazette.*

THE ECONOMY OF STEAM TURBINES IN CRUISERS.—The trials of the H. M. S. Amethyst, just completed, unmistakably demonstrated the economy of the Parsons steam turbine, especially at higher powers, as the opportunity presented itself of accurately comparing the results obtained with those arrived at, under exactly the same conditions, in three cruisers of similar form, draft and displacement, with the one difference that they were propelled by ordinary reciprocating engines. The vessels, known as the Topaze class, are of 3000 tons displacement and were designed for a speed of 21¼ knots, with 9000 indicated hoursepower. The trials of the ships with reciprocating engines proved that the utmost that could be done with any degree of reliability was 22.34 knots; the Amethyst, for the same boiler power, easily steamed at 23.63 knots—an increase in speed of 1.29 miles per hour. But when it is noted that this gain was realized with easier steaming of the boilers, with the same weight of machinery, with no vibration of the ship—which enormously assists towards accuracy of gunfire—and with quite 10 per cent less coal per hour, and a correspondingly greater radius of action, the superiority of the turbine will at once be appreciated. The absence of reciprocating parts reduces possibilities of wear and tear. The height required for the turbine machinery is 20 inches less, so that it can be more easily housed under a protective deck. The air pressure in the stokehold was ½ inch less, so that there was, as a result, less stress on the boilers. The manœuvering capabilities of the

turbine cruiser proved quite as satisfactory as the reciprocating-engine ships. The time required for stopping from full speed ahead, or from starting from dead stop, ranged from 7½ to 20 seconds, and only a few minutes was required to increase the ship's speed from 10 knots to 22 knots, so that the tactical advantage of the turbine need not be doubted. Economy is the one great element proved by the exhaustive and very carefully-conducted trials of all four ships. At low power for 10 knots speed the water consumption was about 23 per cent higher than in the reciprocating-engine ship. This excess, however, will be very materially reduced when the exhaust steam from the auxiliary engines on board the Amethyst is passed into the low-pressure receiver instead of into the condenser—a

Fig. 1 WATER CONSUMPTION PER HOUR AT VARIOUS SPEEDS

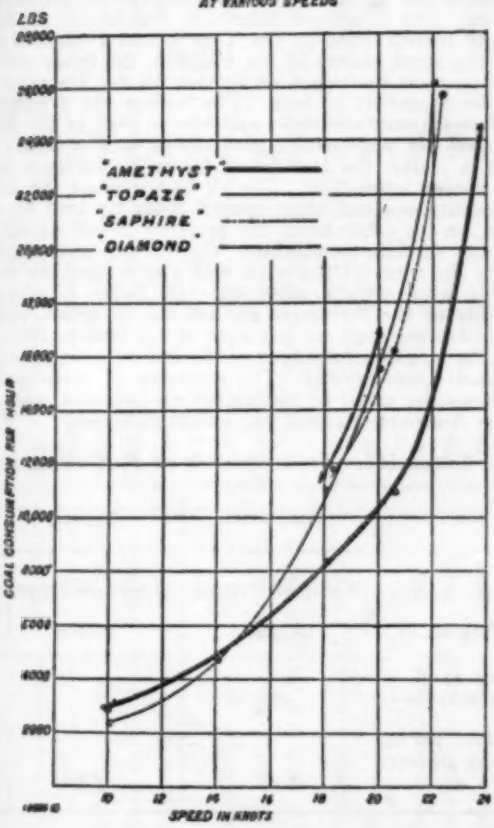


practice carried out in the other ships. At 14 knots the conditions are, so far as economy is concerned, more equal; but when the speed was increased to 18 knots, it was found that the consumption on board the Amethyst was something like 20 per cent less; at 20 knots it was nearly 30 per cent less; and at the higher speed the improvement was still greater. The influence of this economy on the radius of action is very marked; for instance, the turbine-propelled ship could, with her 750 tons of coal on board, steam 3160 sea-miles at 20 knots, as compared with 2140 miles by the cruisers fitted with the ordinary machinery.

Turning now to the details which we have collected from the trials of these respective vessels, we may note first that the Amethyst—the vessel supplied by steam turbines by the Parsons Marine Steam Turbine Company,

Limited, of Wallsend-on-Tyne—was constructed by Sir. W. G. Armstrong, Whitworth & Co., Limited, at the Elswick works. The other three ships are the Sapphire—constructed and engined by the Palmers Shipbuilding and Iron Company, Limited—and the Topaze and Diamond—constructed and engined by Messrs. Laird, Cammell & Co., at their Birkenhead works. So far as the hull is concerned, all four vessels are alike. With a length of 360 feet and a beam of 40 feet, they displace 3000 tons when the draft is 14 feet 6 inches; in all of the trials this draft was either

Fig. 2. COAL CONSUMPTION PER HOUR AT VARIOUS SPEEDS



equalled or slightly exceeded. They are third-class cruisers, and will probably be used for despatch work, although the speed of the Amethyst may justify her being regarded as a scout. The armament includes twelve 4-inch guns—one on the poop, a bow-chaser on the forecastle, and five on each broadside on the upper deck. These guns have hoods of 4-inch armor. In addition, there are eight 3-pounders, three Maxim guns and two torpedo-launching tubes on the upper deck.

The boilers are of the "express" water-tube type, and it was specified that the coal burnt per square foot of heating surface should not exceed 1 pound. In the Amethyst, the Yarrow boiler, as constructed by Messrs.

Hawthorn, Leslie & Co., has been adopted, the fire-grate area being 493½ square feet, and the heating surface 25,968 square feet, a ratio of 1:52.5. In these boilers the constructors have again utilized the method of adopting the two outer rows of tubes for heating the feed-water. The top of the water-drum to which these tubes are connected is isolated by a diaphragm-plate from the remainder of the drum, and into this space the feed-water is discharged. This is an important subject in turbine driving, because, owing to the fact that a high vacuum is desiderated, it results that the temperature of the feed-water is less than in other ships by about 20° F. The effect of the utilization of these two outer tubes is to heat the water without adding materially to weight carried—always an important matter in warship design. The Amethyst tubes are 1⅛ inches in diameter. The Laird-Normand boilers fitted to the Topaze and Diamond have 1¼-inch tubes, but in the Reed boilers in the Sapphire the tubes are of 1 $\frac{7}{16}$ inch diameter. In all cases the two rows nearest the fire are greater in internal diameter to the extent of ¼ inch. The boilers are arranged, in all the ships, two in the forward stokehold and four in each of the other two. All of the ten boilers are single-ended, and placed back-to-back. In each ship the stokehold is closed, the fans being driven by enclosed steam engines, arranged for forced lubrication. The air-pressures on the full-power trial in the reciprocating-engined ships ranged from 1.7 inch to 2.6 inches; in the Amethyst, on the other hand, the pressure at full power was 1.7 inch on one trial and 1.6 inch on another. The former was run in very rough weather, when the force of the wind was 4 to 6, and the other on Wednesday of this week with a calm sea. In Table I, where the results of all the trials of the Amethyst are set out in detail, it will be noted that at low power the high air pressure of 1.9 inch is recorded. This is explained by the fact that only four of the boilers were used; in the other trials the pressure was normal. The summary of boiler performances in Table III, shows the result of the higher air pressure, and also indicates how easily the Amethyst attained her excess in speed.

TABLE III.—*Boiler Results at Full Power.*

	Amethyst.	Topaze.	Sapphire.
Type.....	Modified Yarrow	Laird-Normand	Reed
Heating surface sq. ft..	25,968	26,000	26,010
Coal burnt per sq. ft. of heating surface, lbs..	.93	1	.98
Steam generated per sq. ft. of heating surface, lbs..,.....,....	7.35	8.02	8.7

The reciprocating engines on the two Laird cruisers and on the one Palmers ship are distinctly suggestive of the destroyer type, having at back and front forged steel columns, braced diagonally. The scantlings are heavier and the working parts are more substantially generally, while the number of revolutions is considerably less. The high-pressure cylinders are 24¼ inches in diameter, the intermediate cylinders 38½ inches, and the two low-pressure cylinders 42¼ inches in diameter, the stroke being 24 inches. It was anticipated that the full power of 9800 indicated horse-power would be developed when the machinery was making 250 revolutions, equal to a piston speed of 1000 feet per minute. In the case of the Topaze the air pumps are worked off the main engines. This was the first of the

TABLE I.

RESULTS OF STEAM TRIALS OF H. M. S. AMETHYST WITH PARSONS STEAM-TURBINES.

Date of trial		October 19 and 20	October 24 and 25	October 31 and November 1	November 4	November 8	November 16
Duration of trial		24 hours	24 hours	30 hours	8 hours	4 hours	4 hours
Draft of water (mean)		14 ft. 7 in.	14 ft. 7 in.	14 ft. 6 in.	14 ft. 8 in.	14 ft. 7 in.	14 ft. 6 in.
Speed of Ship, knots		10	14.062	18.186	20.6	23.06	23.63
Air pressure in stokeholds		1.9 in.	0.3 in.	0.45 in.	0.46 in.	1.7 in.	1.6 in.
Steam pressure in boilers		259 lb.	263 lb.	246 lb.	255.2 lb.	243.7 lb.	260.6 lb.
Steam pressure in receivers	Cruising H. P.	94 "	216 "	—	—	—	—
	" I .P.	19 "	61.2 "	137.5 lb.	190.6 lb.	—	—
	Main H. P.	2.7 "	18 "	53.7 "	75.6 "	158.3 lb.	174.3 lb.
	" star. L. P.	Vac. 21.7 in.	Vac. 10.8 in.	1.3 "	6.1 "	23.5 "	27.3 "
	" port L. P.	" 19.9 "	" 11.8 "	Vac. 1.3 in.	4.8 "	24.6 "	27.3 "
Vacuum in condensers	Starboard	26 in.	27 in.	26.6 "	27.8 in.	26.9 in.	26.5 in.
	Port	26.7 "	26 "	27.6 "	27.8 "	27.0 "	27.4 "
Revolutions	Center	167.2	237.4	319.8	361.1	436	449.4
	Starboard	198.2	289.7	391.6	450.8	488.8	484
	Port	204.2	290.5	348.1	402.1	492.9	490
Consumption of water per hour		28,260 lb.	44,090 lb.	76,493 lb.	100,606 lb.	176,845 lb.	190,525 lb.
" coal per hour		2,893 "	4,725 "	8,372 "	10,987	24,095 "	24,412 "

TABLE II.

RESULTS OF STEAM TRIALS OF H. M. S. TOPAZE, WITH RECIPROCATING ENGINES.

		August 1 and 2, 1904		August 2 and 3, 1904		July 12 and 13, 1904		Aug. 7 and 8, 1904		August 10, 1904		July 28, 1904		August 13, 1904	
Date of trial															
Nature of trial		24 hours at 10 knots		24 hours at 14 knots		30 hours at 18 knots		30 hours at 18 knots		8 hours at 20 knots		4 hours at full power		4 hours at 21¾ knots	
Speed of vessel, knots		10.058		14.08		18.1		18.060		20.063		22.103		21.826	
Steam pressure in boilers, lb. p. sq. in.		200		198		240		270		250		271		276	
Number of boilers in use		4		6		8		8		10		10		10	
Air pressure in boiler rooms, in.		0.2		0.28		1.19		0.87		0.83		1.8		2.04	
Vacuum	Starboard, in.	25.7		26.0		24.8		25.7		25.2		24.0		25.3	
	Port, in.	25.3		25.0		24.0		24.8		24.4		24.0		23.8	
Revolutions	Starboard	107.5		150.7		193.6		195.7		219.6		245.6		242.8	
	Port	106.5		150.3		196.8		195.7		219.2		245.5		243.8	
	Mean	107.0		150.5		197.7		195.7		219.4		245.55		243.3	
		Starboard	Port	Starboard	Port	Starboard	Port	Starboard	Port	Starboard	Port	Starboard	Port	Starboard	Port
Mean pressure in receivers	High, lb.	75	74	142	150	192	190	188	190	216	214	244	245	240	237
	Intermediate, "	13.6	13.9	30	46	59	60	59	61	74	76	89.6	94.4	89	96.5
	Low, "	3.6 in. vac.	5.2 in. vac.	2.8	4.2	12	13.8	8.7	10.6	14	15	22.2	23.1	22.5	23.9
Mean pressure in cylinders	High, "	20.82	20.88	38.57	34.63	74	62	64.6	61.8	80	80	115	111	102.6	94.5
	Intermediate, "	6.94	7.0	15.57	15.15	26.1	23.4	26.7	27.3	34.2	36.6	44.5	47.2	44	49.9
	Low forward, "	6.34	6.07	9.25	10.36	13.8	15.2	13.20	15.04	16.7	17.26	20.1	21.5	20.7	22.84
	Low aft, "	5.69	5.82	8.99	9.75	13.8	15.5	13.55	15.37	16.61	17.35	21.5	22.7	21.46	23.6
Mean indicated horsepower	High	125	125	326	292	821	684	706	678	988	982	1585	1534	1305	1292
	Intermediate	106	105	331	321	783	790	735	755	1058	1132	1541	1637	1508	1716
	Low forward	116	110	237	205	466	511	441	501	623	644	841	897	853	946
	Low aft	104	106	230	249	467	521	449	511	620	647	897	946	885	978
Indicated horsepower		897		2251		4,493		4,776		6,629		9,868		9,573	
Consumption of coal per hour, lb.		2296		4640		10,484		10,900		15,451		26,150		27,700	
Consumption of coal per indicated horsepower per hour, lb.		2.56		2.06		2.3		2.28		2.31		2.65		2.89	
Consumption of water per hour per indicated horsepower, lb.		23.74		18.77		19.0		18.95		20.07		20.18		21.93	
Consumption of water per hour, lb.		21,294		42,260		94,807		90,600		134,248		199,140		209,960	

TABLE IV.—*Analysis of Water-Consumption Results.*

	Amethyst.	Topaze.	Sapphire.	Diamond.
24 Hours' Trial at 10 Knots.				
Indicated horsepower	897	897	.....	.....
Speed, knots	10	10.058	.....	.....
Total water per hour, lbs.	26,260	21,294	.....	.....
Water per I. H P. per hour, lbs.	29.3	23.74	.....	.....
24 Hours' Trial at 14 Knots.				
Indicated horsepower	2,250	2,251	.....	.....
Speed, knots	14.062	14.08	.....	.....
Total water per hour, lbs.	44,090	42,260	.....	.....
Water per I. H. P. per hour, lbs.	19.6	18.77	.....	.....
30 Hours' Trial at 18 Knots.				
Indicated horsepower	4,770	4,776	5,012	5,074
Speed, knots	18.186	18.069	18.47	18
Total water per hour, lbs.	76,493	90,500	99,200	96,410
Water per I. H. P. per hour, lbs.	16	18.95	19.8	19
8 Hours' Trial at 20 Knots.				
Indicated horsepower	7,280	6,689	7,281	7,145
Speed, knots	20.6	20.063	20.68	20
Total water per hour, lbs.	100,606	134,248	144,160	137,930
Water per I. H. P. per hour, lbs.	13.8	20.07	19.8	19.31
4 Hours' Trial at Full Power.				
Indicated horsepower	13,000 14,000	9,573 9,868	10,200	*
Speed, knots	23.06 23.63	21.826 22.103	22.34	.....
Total water per hour, lbs.	176,845 190,525	209,950 199,140	226,440	.....
Water per I. H. P. per hour, lbs.	13.6 13.6	20.18 21.93	22.2	.....

TABLE V.—*Analysis of Coal-Consumption Results.*

	Amethyst.	Topaze.	Sapphire.	Diamond.
Indicated horsepower	897	897	.....	.....
24 Hours' Trial at 10 Knots.				
Total coal burnt, tons	31	24.6	.....	.....
Total burnt per hour, lbs.	2,893	2,296	.....	.....
Total burnt per hour per I. H. P., lbs.	3.22	2.56	.....	.....
Evaporation per pound of coal, lbs.	9.1	9.3	.....	.....
Miles run per ton of coal	7.42	9.75	.....	.....
24 Hours at 14 Knots.				
Indicated horsepower	2,250	2,251	.....	.....
Total burnt, tons	50.63	49.7	.....	.....
Total burnt per hour, lbs.	4,725	4,640	.....	.....
Total burnt per I. H. P. per hour, lbs.	2.1	2.06	.....	.....
Evaporation per pound of coal, lbs.	9.35	9.13	.....	.....
Miles run per ton of coal	6.6	6.8	.....	.....
30 Hours at 18 Knots.				
Indicated horsepower	4,770	4,776	5,012	5,074
Total coal burnt, tons	112.13	146	157	154.3
Total coal burnt per hour, lbs.	8,372	10,900	11,720	11,520
Total coal burnt per hour per I. H. P., lbs.	1.75	2.28	2.338	2.27
Evaporation per pound of coal, lbs.	9.15	8.3	8.45	8.35
Miles run per ton of coal	4.8	3.7	3.53	3.5

*The Diamond has not yet run her contract full power.

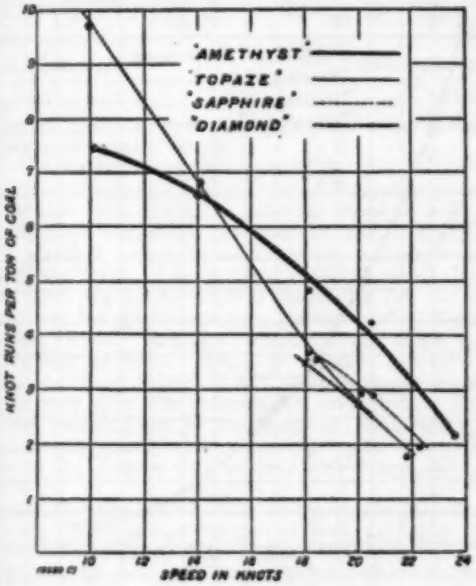
8 *Hours at 20 Knots.*	Amethyst.	Topaze.	Sapphire.	Diamond.
Indicated horsepower	7,280	6,689	7,281	7,145
Total burnt, tons	39.06	55.2	57.65	59.1
Total burnt per hour, lbs.	10,937	15,451	16,142	16,570
Total burnt per hour per I. H. P., lbs.	1.5	2.31	2.217	2.32
Evaporation per pound of coal, lbs.	9.7	8.7	8.94	8.34
Miles run per ton of coal	4.22	2.9	2.86	27
4 Hours at Full Power.				
Indicated horsepower	13,000 14,000	9,573 9,868	10,200	.....
Total coal burnt, tons	42.9 43.6	49.5 46.6	45.87	.....
Total coal burnt per hour, lbs.	24,035 24,412	27,700 26,130	25,688	.....
Total coal burnt per hour per I. H.P. lbs.	1.85 1.74	2.89 2.65	2.518	.....
Evaporation per pound of coal, lbs.	7.35 7.8	7.56 7.95	8.75	.....
Miles run per ton of coal	2.15 2.17	1.76 1.9	1.95	.....

vessels laid down, and subsequent to the order being placed it was decided that in the others separate air pumps should be utilized, consistent with later day practice, adopted in view of the better vacuum obtainable by this method. The auxiliary machinery includes two electric lighting forced-lubrication engines, the dynamos being of 350 amperes capacity at 150 volts, when the engines are making 450 revolutions per minute; two evaporators, capable of evaporating 60 tons per day; and two distilling condensers, capable of condensing steam from the evaporators at the rate of 20 tons per day, in addition to the usual donkey and other pumps. There is, of course, the usual air-compressing machinery adopted in warships, while in each boiler room there is one main and two auxiliary feed-pumps. The enumeration of this auxiliary machinery is justified, because of the question of economy at low speeds, which will be referred to later. The Topaze, in addition to making her usual contract trials, was required to carry out trials corresponding exactly with those prescribed for the Amethyst. The contract trials were thirty hours at the power which would give 18 knots, eight hours at the power which would give 20 knots, and four hours at full power. In no case were the contractors responsible for the legend speed, which was 21¼ knots, but in all cases it was exceeded.

Before entering upon a consideration of the comparative results, it will be well to indicate generally the arrangements of the turbine machinery on board the Amethyst. The difficulty hitherto urged against the turbine for cruisers is the low economy at the cruising speed at which all warships run for 95 per cent of their time. The Parsons Company have overcome this objection to a greater or less extent in the Amethyst by fitting separate turbines for cruising. Thus, at the forward end of the port and starboard shaft respectively there is fitted a high and intermediate-pressure cruising turbine. On the same shaft there are the usual low-pressure turbines for going ahead and the astern turbines; while on the center shaft there is a main high-pressure turbine. The cruising high-pressure turbine has a 44-inch drum; the intermediate cruising turbine, one of the same diameter, but with different blading; the main high-pressure turbine drum is of 60-inch diameter, and the low-pressure turbine of the same diameter, but longer and with different blades. All increase in diameter to admit of the expansion of steam. In cruising it is possible to obtain a great range of expansion, the steam first entering the high-pressure cruising turbine, and passing to the intermediate cruising turbine, thence to the main high-pressure turbine, and through the low-pressure turbines, working *in vacuo*,

to the condenser. It will be noticed from the detailed results of the steam turbines on the Amethyst in Table I that this was the arrangement adopted until the speed attained 14 knots; on the trial at 18 knots the cruising high-pressure turbine was cut out, steam initially entering the intermediate cruising turbine, while in one low-pressure turbine there was a pressure of 1.3 pounds, in the other a vacuum. This condition continued at the 20-knot trial, the pressures in all cases, of course, being increased in view of the greater steam supply. At full speed both cruising turbines were cut out, steam entering only the main system. In this way a high rate of expansion of steam at all speeds was attained. The effect on the revolutions of the respective shafts, shown in Table I, is noteworthy, especially on the 18- and 20-knot trials.

Fig. 3. KNOTS RUN PER TON OF COAL

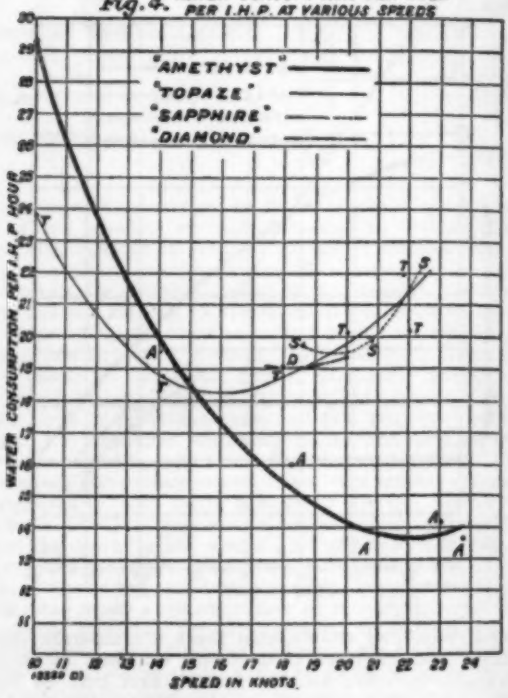


It will be understood, of course, that there are separate steam leads to the high-pressure and intermediate-pressure cruising, as well as to the main high-pressure, turbines, another feature that may be noted is, that forced lubrication has been adopted in connection with the turbine bearings, two small direct-acting oil pumps by Weir having been fitted for this purpose. Separate air-pumps by Weir are used for exhausting from the turbines. The Parsons system of vacuum intensifier had not been introduced when the machinery of the Amethyst was designed, and, unfortunately, the condenser is too low in the ship to admit of this important addition being made now. A dry-air pump, as in the Londonderry, would, however, add to the efficiency.

The water-consumption results were arrived at by measuring the feed-water in specially-constructed tanks. On the upper deck there were four tanks for the main feed—two on the port and two on the starboard side—each pair communicating to pipes running to the feed-tanks. The pipe between the pair on the port side, as well as that between the two on the starboard side, had a simple truncock, so that as soon as one tank was

filled the flow could be diverted into the other, and the hour or half-hour readings of the gauge determined the amount of water used; the results therefore are reliable. On Table IV we have set out the water consumption per hour and the rate per unit of power. The power in the case of the Amethyst is, of course, assumed; but as the form of the ship is identical in all cases, we cannot be far wrong in taking the same powers for the Amethyst as was required to drive the other ships at corresponding speeds. It is not, however, so easy to deduce the power for the speeds attained by the Amethyst in excess of those realized by the Topaze; but the projection of a progressive speed curve affords a moderately accurate assumption. As, however, objection might be taken to this assumed power, we have, in Fig. 1, plotted the water consumption per hour for

Fig. 4. WATER CONSUMPTION PER HOUR PER I.H.P. AT VARIOUS SPEEDS



various speeds without regard to the power. It will be noticed that for the lower powers the turbine required more steam, but, as we have already mentioned, the Amethyst has not the advantage of the utilization of the exhaust steam from the auxiliary machinery. In the Topaze, for instance, when running at 10 knots, the water used for the auxiliary machinery was 4538 lbs. per hour, or over 21 per cent of the total, and at 14 knots it was 5672 lbs., or over 13 per cent of the total given in Table IV. Although most of the auxiliary engines are compound, some are only simple expansion, the steam exhaust from them is thus by no means a negligible quantity in respect of economy. In the reciprocating-engined ships this exhaust steam is led into the low-pressure cylinder receiver, whereas in the turbine ship it was passed into the condenser. The advantage of the reciprocating engine at low powers will greatly diminish, if it does not

disappear entirely when these conditions are alike. The advantage of the turbine vessel in economy after 18 knots is obvious, and at 20 knots is very marked, while at the designed speed of 21¾ knots it is nearly 30 per cent.

The steam consumption of the Topaze shows a satisfactory thermal efficiency. Taking the water used for the main engines only, we find that at 18 knots the steam consumption was 15.45 lbs., while at 14 knots it was 16.25 lbs., and at 20 knots 16.91 lbs. The trials conducted by the research committee of the Institution of Mechanical Engineers recorded as the best performance 13.35 lbs., per horsepower hour; but this was in a ship where economy was the main consideration rather than speed for the minimum of weight. Accepting the horsepower assumption, the performance of the turbine machinery proves to be more satisfactory than this exceptional result recorded by the research committee. At 20 knots the steam consumption of the turbines, even including the auxiliary machinery, was 13.8 lbs., which is a very exceptional figure, but was carefully tested. At 18 knots, where again there can be no question of the power in view of the comparison with the other ships, the water consumption was 16 lbs., including that for auxiliary machinery, so that it would be a safe assumption to say that the main turbines were not taking more than 13 lbs., which is probably a better result than has been realized by any high-speed reciprocating machinery in normal work.

In regard to the coal-consumption results set out in Table V, there is not, perhaps, the same measure of reliability. Disturbing variants come in the weather, the skill of stokers, the calorific value of coal, &c.; but it is important to note, especially from the diagram Fig. 2, that the coal results corroborate the water or steam economy of the turbine.

In the lower power trials of both ships it will be noted that the evaporative results are fairly constant—about 9 lbs. to 9¼ lbs. per pound of coal; but with the pressing of the boilers to a greater extent, there was a slight falling off. In the case of the reciprocating-engined ships, the boilers were at full power burning 50 lbs. to 57 lbs. per square foot of grate per hour, which even with perfect control of the stokers is not conducive to high evaporation; but even then the evaporation only slightly fell below 8 lbs. in the Topaze and was 8.75 lbs. in the Sapphire. The better result realized on the second full-power trial of the Amethyst was due to better weather, and in the case of the Topaze to less restrictive conditions in the machinery-room.

A better measure of the coal economy is perhaps the distance travelled by the ships at any given speed per ton of fuel, and this also is given in Table V, and plotted in Fig. 3. Here, again, the Topaze has the advantage of the power recovered from the exhaust from the auxiliary machinery, excepting at full power; but from 14½ knots upwards the Amethyst shows superiority. It is most marked at the higher powers; and a good measure of this is the radius of action. From the coal consumption per hour for the various speeds we have deduced the figures given in Table VI. At 18 knots the turbine-driven ship has an advantage equal to 30 per cent over the Topaze, and 20 knots of 47 per cent.

TABLE VI.—*Radius of Action* (750 *Tons Coal Capacity*).

Speed in Knots.	Amethyst.	Topaze.
10	5570	7300
14	4950	5100
18	3600	2770
20	3160	2140
22	....	1420
23.63	1620	....

A word may be said about the speed results. The propulsive efficiency is in all cases very favorable. In the Topaze, four-bladed propellers were

fitted on each of the two shafts, and in the Sapphire three-bladed screws; but the diameter, pitch, and area were in both cases exactly the same. Into the results due to these differences we do not propose to enter, but it is satisfactory to know that the propellers on the Amethyst gave an average slip. In this case there was one propeller on each shaft, each of the propellers being three-bladed. The diameter in all cases was 6 feet 8 inches, but the pitch of the side screws was 5 feet 9 inches, the area being 19.48 square feet, while the pitch of the center propeller was 6.56 feet, with an area of 19.64 square feet. At 10 knots the mean slip of the three propellers works out to 11.3 per cent; at both 14 knots and 18 knots, to 13.6 per cent; at 20 knots, to 14.4 per cent; at 23.06 knots, under the very heavy weather conditions to which we have referred, 18.4 per cent; and at 23.63 knots, in a smooth sea, to 17.1 per cent. There is the one other fact that the five runs of the Amethyst, on Wednesday, over the measured mile on the East Coast, north of the Tyne, showed very little variation. The runs were made on slack tide, and the speeds were equal to 23.38 knots, 23.23 knots, 23.53 knots, 23.44 knots, 23.53 knots, giving a mean of 23.42 knots for 473.4 revolutions; but the speed on the four hours' trial was 23.63 knots for 477.6 revolutions.

A concluding reference may be made to the subject of the weight of the machinery. There is practically no difference between the turbine and reciprocating-engined ships, notwithstanding the necessity of having cruising turbines in addition to the usual go-ahead and go-astern turbines. The total for the reciprocating-engined ships ranges from 530 tons to 540 tons, being in the case of the Topaze 537 tons; in the Amethyst the weights work out to 535 tons. Assuming, therefore, that the machinery developed 14,000 indicated horsepower when the vessel made 23.63 knots, it is evident that the power developed per unit of weight was 26 indicated horsepower per ton; whereas in the Topaze it was only 18.3 indicated horsepower per ton. The result, as we have said, proves what has long been established, so far as stationary turbines on land are concerned—that the steam turbine, when running at its full designed speed, is capable of an economy better than that of the ordinary reciprocating engine. As merchant ships are, for 99 per cent of their time, running at their full speed, the gain must be very considerable. In such case, also, it would not be necessary to have cruising turbines, so that there seems no reason why there should not be some saving also in weight.

BOOK NOTICES.

TEXT-BOOK ON NAVAL ENGINES AND MACHINERY, By JOHN K. BARTON, Commander, U. S. N.

This book is evidently written for one specific purpose, and only one, viz., to furnish information to midshipmen and young officers, and the author never loses sight of his subject from beginning to the end. It is free from prolixity or any attempt to swell the volume with irrelevant material. While covering the whole ground pertinent to the subject-matter, there is no part which could have been omitted without positive detriment. The language is simple and direct and very cut clear and easily understood, being obviously made for the book and not clipped, for sake of economy, from some advertising circular.

The text begins with the usual and necessary elementary treatment of the subjects of "Work and Efficiency," "The Action of Steam," "The Slide Valve," "Valve Gear," and "Multiple Expansion Engines"—each subject being presented in accordance with the standard accepted theories and practice, and in a manner found by experience in the class-room to appeal to the understanding of midshipmen.

Whenever it is necessary to illustrate the subject by a sketch, the sketch is taken from a piece of mechanism actually in use in the U. S. Navy on one or more ships.

The foregoing subjects take about one-fifth of the book. This with a chapter on "Curves of Crank Effort," one on "Engine Balancing," and a few pages on the "Theory of Propulsion and Screw Propellers," cover about all of the purely theoretical part of the work, the remainder being wisely devoted to those numerous practical details, the knowledge of which generally determines the degree of success which the young engineer will have in the engine-room.

In Chapter X the subject of the Steam Engine Indicator is illustrated with sufficient fullness to enable the young student to use the instrument in a way to get with it all the information he is likely to require.

Chapter XII is devoted to explaining the general plan on which the drainage, pumping and fire systems are laid out, the water-tight compartments numbered and the doors operated. All the drawings, as before, have reference exclusively to the practice in U. S. naval vessels.

Chapter XV gives quite a complete description of the usual numerous auxiliary machines, including the operation of the ice machine and evaporator, and some pertinent remarks on economy in the method of working the latter.

In Chapter XV the steam turbine is treated in a concise and comprehensive manner, freely illustrated and with data from the latest reliable tests.

Chapter XVI gives the general principles underlying the subject of engine balancing, which in these days of high speed reciprocating engines is a subject to which marine engineers are giving a good deal of study. The formulas are deduced and the method of using them illustrated by a practical example.

On the "Operation and Management of Machinery," and the work on shipboard in port, Chapters XVII and XVIII, the author has much to say, and properly so. These subjects in text-books are usually dismissed with a few general observations, giving the student the idea that they are of little moment. Upon taking his station for the first time in the engine-room, he is bewildered by the mass of detail requiring attention, and is rendered decidedly uneasy by the danger incurred if he should fail to do all of the things absolutely necessary to be done. He sees, then, for the first time, that his work has to be more than satisfactory. Failure to make a complete success means running the risk of a bad failure. Also if his subordinates are trusted to look after many seemingly trivial details, he will soon come to grief, for the ordinary enlisted man will neglect his duty just often enough to demonstrate to the officer the necessity for keeping his own eyes and ears wide open all the time. In the chapter in question the details to be looked after are enumerated at sufficient length to give the student a very good general idea of the scope of his work in the engine-room, although it would be manifestly impossible to mention everything, and no amount of instruction can compensate for a want of common sense, together with judgment based on an intimate knowledge of the details of the machinery, and a good knowledge of the strong and weak points of human nature as exemplified in the men on duty there.

Chapter XIX, on the Organization of the Engineer Division, explains the conditions which determine the number of men required in the Engineer Department; the nature and amount of duty to be assigned to each, samples of standard Watch, Quarter and Station Bills, and remarks on the subject of coaling in port and at sea. We note that the Bureau of Steam Engineering, quoted by the author, bases the number of firemen on the supposition that one fireman can fire 60 square feet of grate. It would appear more rational to adopt a common practice in the English merchant marine of basing the number of firemen on the number of tons of coal to be fired per hour, for even with Scotch boilers the rate of combustion varies from 15 pounds per square foot to 45 pounds per square foot of grate, and with water-tube boilers the variation is far greater, depending upon the type and details of the boiler.

The foregoing chapters complete the original matter in the text, and are followed by a most useful appendix of ten short chapters, viz.:—

Part [A].—U. S. Naval Regulations on the care of engines and boilers, a subject very likely to be overlooked unless prominently brought forward in this way in the text-book.

Part [B].—List of spare parts usually carried, is convenient for hasty reference, and not easily obtained when wanted.

Parts [C, D, E].—The usual hyperbolic logarithms and steam tables.

Parts [F, G, H].—U. S. Naval Specifications for Stores and Material. This is of the greatest service on foreign stations where the inspection and

test of materials and stores must be made by the Senior Engineer Officer of the ship. The number and variety of qualities of such things offered by contractors is most confusing, and naturally the price alone is no proper criterion of the quality.

The dimensions of the parts of naval engines being figured so close, it is necessary in the case of any repair work that the engineer should know exactly how the quality of the metal he procures abroad compares with that of the piece to be replaced. This is especially true in the case of steel forgings, as the U. S. Naval standard is much higher than that required by any of the foreign machinery specifications.

Part [I].—On the economy of different methods of working an evaporator is worthy of thoughtful attention.

Part [J].—Examination Questions for Line Officers is a good syllabus, covering the most important points to which their attention should be given. It will doubtless receive the consideration to which it is entitled, by many of the ambitious young officers in the service, who want to become engineers in fact, if not in name.

In conclusion the author is to be congratulated upon producing a text-book of just the scope and character which has been wanted for many years by every instructor in the Department of Steam Engineering at Annapolis, and by most of the midshipmen as well as by many older officers in the service, who have heretofore been obliged to ransack borrowed manuscript note-books and miscellaneous pamphlets of uncertain value, and not easily obtained. W. F. W.

THE INSTITUTE has received from the publishers, Berger-Levrault & Cie., 5 rue des Beaux-Arts, Paris, a copy of the new and revised edition of Commandant de Balincourt's well-known book descriptive of the fighting fleets of the world. It seems that the Russo-Japanese War has so stimulated the demand for works of this sort that the previous edition was exhausted long before the period anticipated, and the author, though laboring under the great disadvantage of being on sea duty in the Far East, was obliged to undertake its immediate revision.

Although "Les Flottes de Combat en 1904" only pretends to differ from its predecessor in registering the additions made during the last eighteen months to the naval strength of the various powers, the revision has increased its value, already great. Every naval officer would do well to possess himself of one of these books.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut-Com. A. D. Brown, U.S.N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U.S.N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U.S.N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap. U.S.N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U.S.N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U.S.N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U.S.N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U.S.N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U.S.N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U.S.N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U.S.N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U.S.N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U.S.N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U.S.N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U.S.N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U.S.N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORT FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U.S.N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins, U.S.N.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U.S.N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U.S.N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U.S.N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U.S.N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U.S.N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U.S.N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U.S.N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U.S.N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U.S.N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U.S.N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U.S.N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U.S.N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U.S.N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U.S.N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U.S.N.I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U.S.N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U.S.N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U.S.N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U.S.N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U.S.N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U.S.N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U.S.N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U.S.N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U.S.N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U.S.N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U.S.N.

1904.

The Fleet and its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL, AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-second year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life members fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

OFFICERS OF THE INSTITUTE.

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Lieut.-Comd'r W. H. G. BULLARD, U. S. Navy.
Lieutenant R. H. JACKSON, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Professor PHILIP R. ALGER, U. S. Navy. (ex-officio.)

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1905.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

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CONTENTS.

	PAGE
The Korea's Wardroom Mess. A True Story. By Rear-Admiral Caspar F. Goodrich, U. S. N.	695
A Study of Attacks upon Fortified Harbors. By Lieut.-Commander, W. L. Rodgers, U. S. N.	709
Operations of the Navy and Marine Corps in the Philippine Archipelago, 1898-1902. By Lieut.-Commander A. P. Niblack, U. S. N.	745
A Method of Determining the Latitude at Sea Without Time. By X.	755
The Significance of Overcrowding. By Surgeon Henry G. Beyer, U. S. N.	759
Desertion and Its Prevention. By Captain A. S. Williams, U. S. M. C.	769
The Battle of Ciudad Bolivar and the End of the Revolution in Venezuela. By Lieut. Mark St. Clair Ellis, U. S. N.	779
Rifling. By Professor Philip R. Alger, U. S. N.	791
Methods of Estimating the Coal Endurance of a Naval Vessel. By Naval Constructor D. W. Taylor, U. S. N.	811
Memorabilia of the Old Navy. By Rear-Admiral Caspar F. Goodrich, U. S. N.	823
Freedom of Discussion in the Institute Proceedings. By Professor Philip R. Alger, U. S. N.	831
Discussion,	833
Professional Notes,	841
Book Notices,	915
List of Prize Essays,	919
Officers of the Institute,	933
Special Notice.—Naval Institute Prize Essay, 1905,	934
Advertisements.	

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INDEX TO ADVERTISERS.

Name.	Manufacturers of or dealers in.	Post office address.	Page.
B			
Babcock & Wilcox Co., The	Forged Steel Water Tube Marine Boilers.	Bayonne, New Jersey	4
Baeder Adamson & Co.	Hair Felt, etc.	No. 730 Market St., Phila., Penna.	20
Bernstein Mfg. Co.	Metallic Bedsteads and Aseptic Hospital Furniture.	3rd & Westmoreland Sts., Philadelphia, Penna.	11
Berwind-White Coal Mining Co.	Proprietors, Miners and Shippers of Coal.	No. 1 Broadway, New York, N. Y.	16
Binney & Smith Co.	Hays' Water Proof Marine Glue.	81-83 Fulton St., New York, N. Y.	35
Blake Mfg. Co., Geo. F.	Marine Catalogue	114 Liberty St., New York, N. Y.	36
Bonner & Co., Wm. T.	Engineers and Contractors	53 State St., Boston, Mass.	12
Borden's Condensed Milk Co.	Condensed Milk and Evaporated Cream.	71 Hudson St., New York, N. Y.	28
Bruce & Co., Edward B.	Wine and Spirit Merchants	Baltimore, Maryland	31
C			
California Powder Works, The	Military, Black Blasting Powder and Dynamite.	320 Market St., San Francisco, California.	27
Chy, Bock & Co., Henry	Cigars and Cigarettes	Calle de Cuba Num. 37 Havana.	10
Continental Iron Works, The	Morison Suspension Furnaces	West and Calyer Sts., N.Y., Borough of Brooklyn.	13
D			
De La Vergne Machine Co.	Oil and Gas Engines, and Refrigerating Machinery.	Foot of E. 138th St., New York, N. Y.	11
F			
Forbes Co., W. D.	High-Speed, Engines, Blowers, Fans, Steering Engines, Electrical Generating Sets, etc.	Hoboken, New Jersey	15
Friedenwald Co., The	Printers, Lithographers, and Bookbinders.	German and Eutaw Sts., Baltimore, Md.	19
G			
General Electric Co.	Search Lights, Dock Hoists, Fans, Ventilators, Incandescent Lights, etc.	44 Broad Street, New York, N. Y.	14
Goubert Manufacturing Co., The	The Stratton Steam Separator	85 Liberty St., New York, N. Y.	25
H			
Helberger, F. J.	Army and Navy Merchant Tailor.	535 15th St., Washington, D. C.	17
Helvetia Milk Condensing Co.	Mfgs. Condensed Milk and Cream.	Highland, Illinois	8
Holland Torpedo Boat Co.	Submarine Torpedo Boats	11 Pine St., New York, N.Y.	21
Hoopes & Townsend Co.	Bolts, Cold Punched Nuts, Washers, etc.	P. O. Station S., Phila., Pa.	32
Horstmann Co., Wm. H.	Military Equipments	5th & Cherry Sts., Phila., Pa.	24
Hudson-Kimberly Pub. Co.	Publishers of Military Books	Kansas City, Missouri	26
I			
International Smokeless Powder & Dynamite Company.	Pure Nitro-Cellulose, Smokeless Powder.	850 Drexel Building, Philadelphia, Penna.	33
K			
Katzenstein & Co., L.	Flexible Tubular Metallic Packing for Slip Joints on Steam Joints.	357 West St., New York, N. Y.	19
Keystone Structural Co.	Structural Work for Building and Bridge in Iron and Steel.	Harrison Building, 15th and Market Sts., Phila., Penna.	31

INDEX TO ADVERTISERS—*Continued.*

Name.	Manufacturers of or dealers in.	Post office address.	Page.
L			
Lake Torpedo Boat Co....	Submarine Torpedo Boats.....	Bridgeport, Connecticut..	34
Leslie, J. S.....	Railroad and Marine Specialties..	Paterson, N. J.....	38
Lidgerwood Mfg. Co.....	Hoisting Engines.....	96 Liberty St., New York, N. Y.	13
Long Arm System Co.....	Standard, Interchangeable Ship Fittings.	Cleveland, Ohio.....	36
Loomis, Manning Filter Co.	Loomis Filters.....	402 Chestnut St., Phila., Pa.	23
Lunkenheimer Co.....	Lunkenheimer Regrinding Valves.	Cincinnati, Ohio.....	29
M			
McIlhenny's Son, E.....	Tabasco Pepper Sauce.....	New Iberia, La.....	36
N			
Newport News Shipbuilding Co.	Ship Constructors.....	No. 1 Broadway, New York, N. Y.	1
O			
Obermayer Co., S.....	Foundry Supplies.....	Cincinnati, Ohio...	31
Orford Copper Co.....	Nickel for Nickel Steel.....	43 Exchange Place, New York, N. Y.	14
R			
Rasmussen, Harry.....	Boat Builder.....	Essington, Del. Co., Penna.	3
Remington Typewriter Co.	The Remington Typewriter.....	327 Broadway, New York, N. Y.	22
Rice & Duval.....	Tailors.....	231 Broadway, New York, N. Y.	17
Roelker, H. B.....	The Allen Dense Air Ice Machine	41 Maiden Lane, New York.	31
S			
Saunders' Sons, D.....	Pipe-Threading and Cutting Machines.	66 Atherton St., Yonkers, N. Y.	8
Schmidt Co., F. J.....	Navy and Army Tailors.	Annapolis, Md.....	37
Scoville Manufacturing Co.	Copper and German Silver Wire for Electrical Purposes, Gilt Buttons for the Army and Navy.	Waterbury, Connecticut..	3d p. of cover.
Sellers & Co., Wm., Incorporated.	Cranes and Modern Machine Tools.	1600 Hamilton St., Phila., Pa.	9
Shelby Steel Tube Co.....	Cold Drawn Seamless Boiler Tubes.	Frick Building, Pittsburg, Penna.	19
Sipe & Co., James B.....	Japan oil.....	Allegheny, Pa.....	31
Speed & Co., James.....	Wine and Spirit Merchants	Gibraltar.....	3d p. of cover.
Stirling Company.....	Niclausse Water Tube Boiler.....	Pullman Bldg., Chicago, Ill.	39
T			
Taylor, Arthur N.....	Rigger	322 S. Delaware, Phila., Pa.	33
U			
Union Iron Works.....	Builders of Cruisers and Battle Ships.	San Francisco, Cal.....	21
W			
Wagner Typewriter Co....	Underwood Typewriter	220 Broadway, New York, N. Y.	5
Watson & McDaniel Co....	Steam Traps, Reducing Valves Separators and other Specialties.	146 N. 7th St., Phila., Penna.	35
Watson-Stillman Co.....	Hydraulic Tools and Machinery..	46 Dey St., New York, N. Y.	18
Weston Electrical Instrument Co.	Electrical Instruments.....	74 Cortlandt St., New York, N. Y.	12
Wignall, James H..... ...	Boat Builder	Beach & Vienna Sts., Philadelphia, Penna.	30
Williamson Bros. Co.....	Engineers and Iron Founders	Armingo Ave. & Cumberland St., Phila., Penna.	4
Willoughby, A.	Willoughby-St. John Shaking Grate and Bearer Bar.	The Bourse, Phila., Penna.	38

Address.	Page.
Connecticut..	34
New York,	13
	30
Phila., Pa.	23
	28
New York,	1
Place, New	14
Penna.	1
New York,	22
New York,	17
New York.	21
Yonkers,	28
Connecticut..	3d p. of cover.
Phila.,	2
Pittsburg,	19
	31
Chicago,	3d p. of cover.
Phila., Pa.	33
	24
New York,	3
Penna.	26
New York,	18
New York,	13
Phila.	29
Cumberland, Penna.	4
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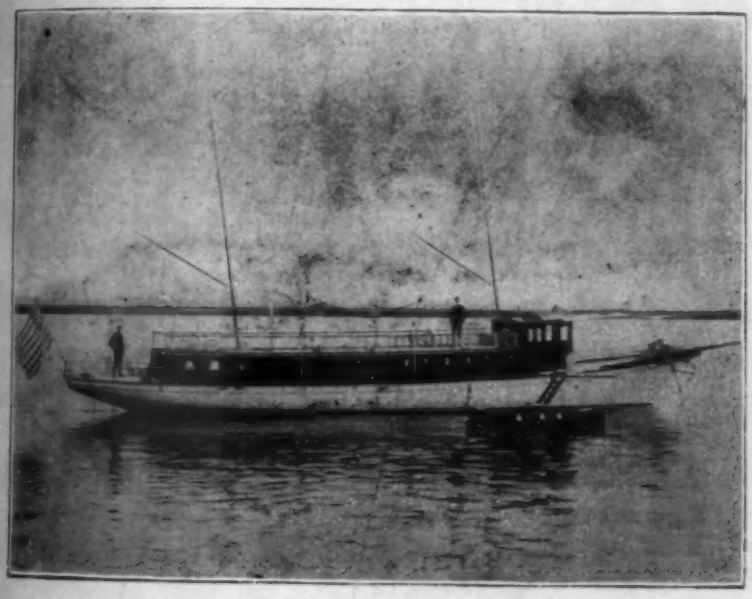

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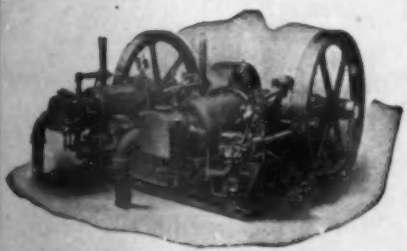

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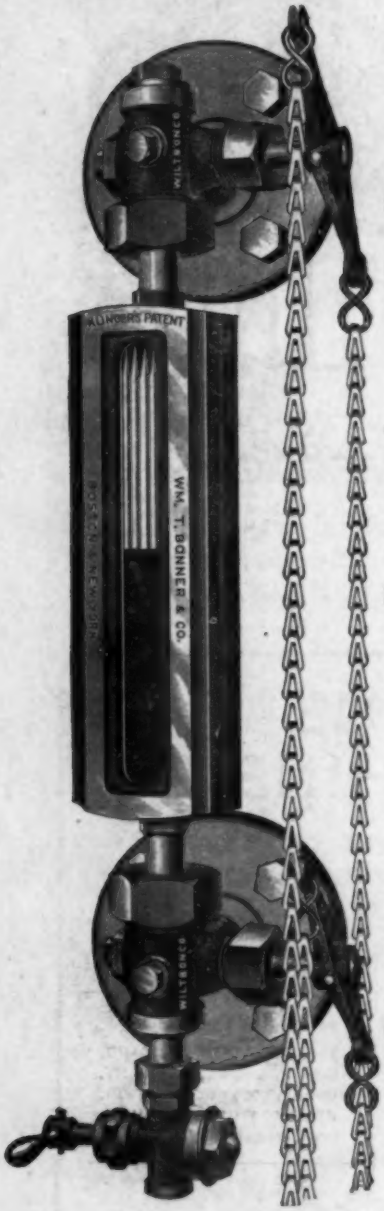

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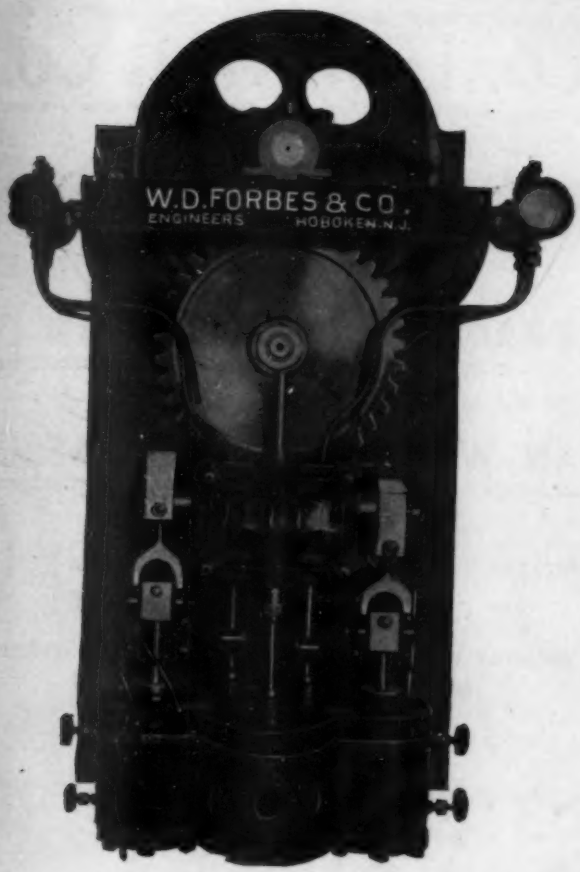

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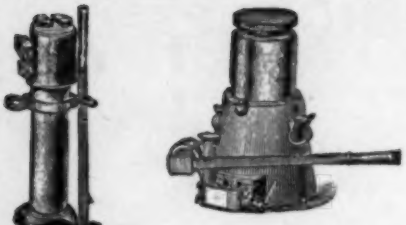

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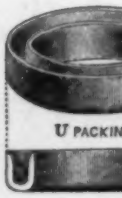

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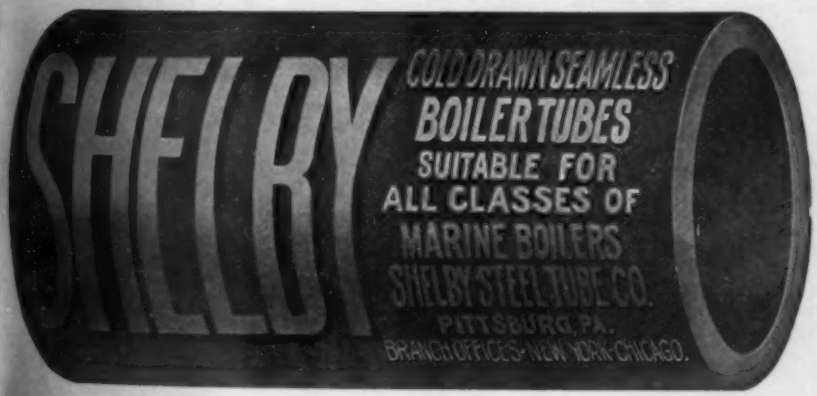

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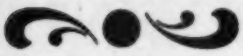

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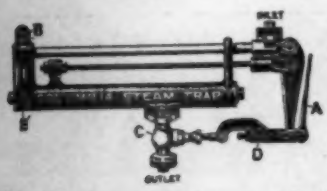

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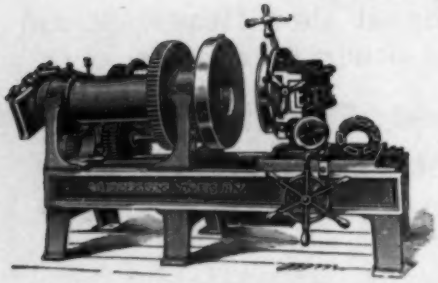

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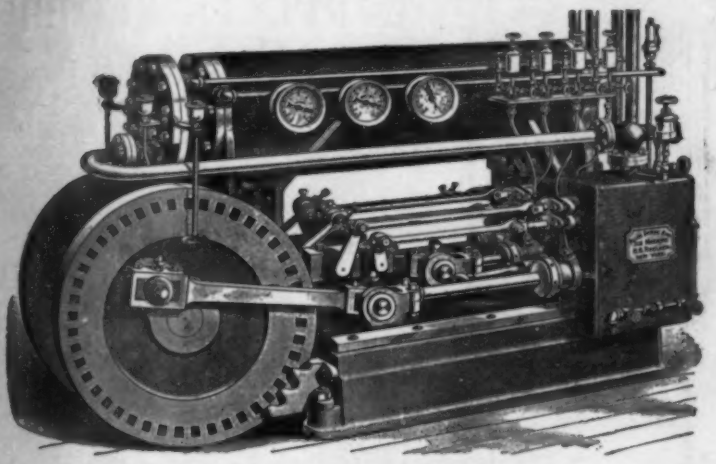

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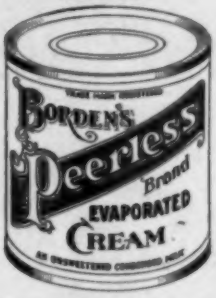

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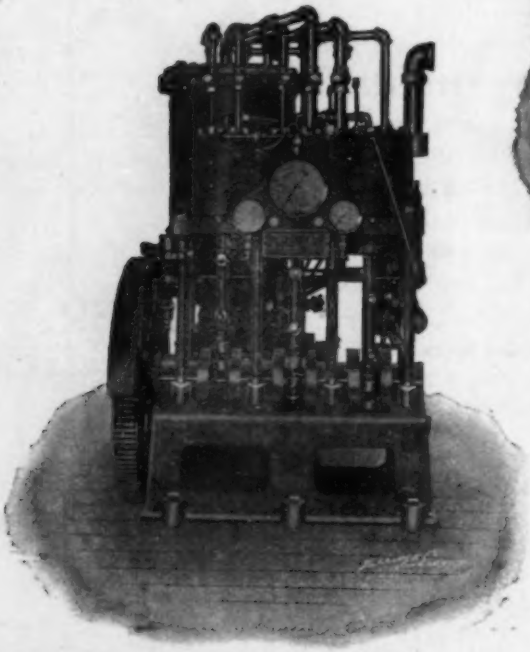

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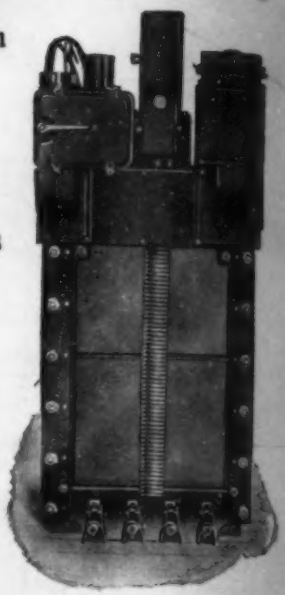

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No. 611,636, October 4, 1898.	No. 716,059, December 16, 1902.
No. 617,750, January 17, 1899.	No. 716,844, December 23, 1902.
No. 638,342, December 5, 1899.	No. 717,101, December 30, 1902.
No. 650,758, May 29, 1900.	No. 719,235, January 27, 1903.
No. 652,970, July 3, 1900.	No. 725,570, April 14, 1903.
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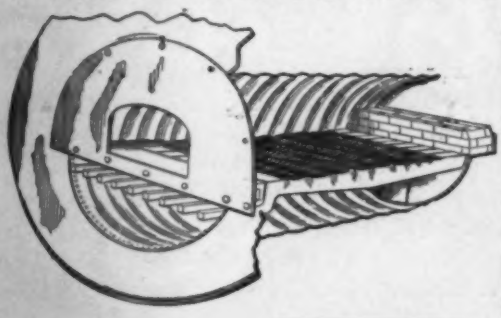

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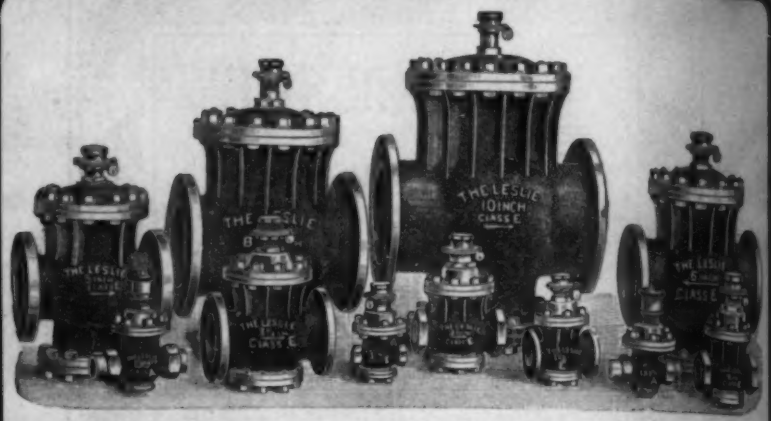

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